



EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT

# TRANSPORT BENCHMARKING

*Methodologies,  
Applications  
& Data Needs*



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EUROPEAN CONFERENCE  
OF MINISTERS OF TRANSPORT

EUROPEAN COMMISSION

# **TRANSPORT BENCHMARKING**

## **Methodologies, Applications & Data Needs**

**PROCEEDINGS OF THE PARIS CONFERENCE, NOVEMBER 1999**

## **EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT (ECMT)**

The European Conference of Ministers of Transport (ECMT) is an inter-governmental organisation established by a Protocol signed in Brussels on 17 October 1953. It is a forum in which Ministers responsible for transport, and more specifically the inland transport sector, can co-operate on policy. Within this forum, Ministers can openly discuss current problems and agree upon joint approaches aimed at improving the utilisation and at ensuring the rational development of European transport systems of international importance.

At present, the ECMT's role primarily consists of:

- helping to create an integrated transport system throughout the enlarged Europe that is economically and technically efficient, meets the highest possible safety and environmental standards and takes full account of the social dimension;
- helping also to build a bridge between the European Union and the rest of the continent at a political level.

The Council of the Conference comprises the Ministers of Transport of 40 full Member countries: Albania, Austria, Azerbaijan, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, FYR Macedonia, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Moldova, Netherlands, Norway, Poland, Portugal, Romania, the Russian Federation, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and the United Kingdom. There are five Associate member countries (Australia, Canada, Japan, New Zealand and the United States) and two Observer countries (Armenia and Morocco).

A Committee of Deputies, composed of senior civil servants representing Ministers, prepares proposals for consideration by the Council of Ministers. The Committee is assisted by working groups, each of which has a specific mandate.

The issues currently being studied – on which policy decisions by Ministers will be required – include the development and implementation of a pan-European transport policy; the integration of Central and Eastern European Countries into the European transport market; specific issues relating to transport by rail, road and waterway; combined transport; transport and the environment; the social costs of transport; trends in international transport and infrastructure needs; transport for people with mobility handicaps; road safety; traffic management; road traffic information and new communications technologies.

Statistical analyses of trends in traffic and investment are published regularly by the ECMT and provide a clear indication of the situation, on a trimestrial or annual basis, in the transport sector in different European countries.

As part of its research activities, the ECMT holds regular Symposia, Seminars and Round Tables on transport economics issues. Their conclusions are considered by the competent organs of the Conference under the authority of the Committee of Deputies and serve as a basis for formulating proposals for policy decisions to be submitted to Ministers.

The ECMT's Documentation Service has extensive information available concerning the transport sector. This information is accessible on the ECMT Internet site.

For administrative purposes the ECMT's Secretariat is attached to the Organisation for Economic Co-operation and Development (OECD).

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## **FOREWORD**

This publication brings together the main contributions and summarises the results of an important conference, organised jointly by the European Conference of Ministers of Transport and the European Commission, on transport benchmarking. This event brought together not only experts and practitioners but also representatives from Governments and international organisations, all of whom were extremely interested in reviewing the benefits and limits of this relatively new technique.

Benchmarking practices have already been widely used in the private sector to back up marketing strategies and efficiency policies. The originality of this conference however lay in its attempt to broaden such methods to the public sector and also to the international community. Concrete examples presented during the conference demonstrated several clear areas where benchmarking could help in the understanding and evaluation of performances in the transport sector. However, they also revealed that we are still far from achieving harmonised, international benchmarking methods. On the basis of concrete cases, the conference stressed the importance of developing effective methodologies, so that transport benchmarking may become a genuinely efficient tool at a European level.

The discussions underlined that transport benchmarking could be a very useful aid in policy making. However, to be successful, it requires a strong participation of policy makers who must play a key role throughout the process and contribute to the definition of clear, measurable and concrete objectives. In order to do so, they must have appropriate statistics and it is thus essential to improve the quality of collected data in order to ensure more reliable transport benchmarking results.

This publication makes a useful contribution to an important and continuing debate.



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## **A. GENERAL BENCHMARKING METHODS**



## **1. BENCHMARKING METHODS AND THEIR APPLICATION**

*by*

**Werner Wobbe<sup>1</sup>  
Enterprise DG, European Commission**

### **Introduction**

Benchmarking is a management tool that developed in parallel with the increasing globalisation of economies. Managers of multinational enterprises needed to compare their operations with those of the best competitors worldwide. In order to become or to stay competitive, firms had to strive for higher productivity, effectiveness and quality. Benchmarking made it possible to set targets and understand how best practice is implemented.

More than a decade later, the public sector discovered that benchmarking could contribute to quality of service and cost-effectiveness, particularly for non-market-regulated activities. Today, public services are considering whether private sector benchmarking principles can be transferred and adapted to public service.

Benchmarking has the potential to affect European affairs. Europe will have to cope with a fundamental transformation of structures: organisation and nature of international trade, capital flows, information networks and technology. Firms operate in many markets and competition is intensifying. Globalisation is driven by government policies to liberalise the regulation of trade and investment and by efficient information technologies, communication and supply networks. There has been a tendency towards greater facilitation of entry by firms into new markets and promotion of diversified cross-border trade, investment and collaboration among firms for product development, production and purchase of inputs and marketing. Globalisation increases competition and, if well managed, has the potential to improve global resource allocation and overall efficiency.

In the face of globalisation, the traditional policy paradigm has changed over the last decade. The creation of the European Internal Market is a significant example. Single Market policies open up protected national markets, including all network services, and expose them to European competition at least. There has also been a switch to a best practice approach. Instead of applying regulations to restrict and shape competition in economies heavily influenced by the state as in earlier decades, competition is taking place on the basis of best practice, to the benefit of consumers. Benchmarking is the method used to encourage the emergence of the best practice approach.

## Benchmarking as a tool

Benchmarking is a tool for supporting and improving policies for achieving the potential of economic activity in a global context. It may address various strategy objectives and may include different elements with a view to an overall improvement process.

The Commission named a High Level Group on Benchmarking (HLGB) which was led by representatives of the business community. The HLGB issued a report in October 1999 to Commissioner Liikanen which recommended initiatives concerning competitiveness and benchmarking in general.<sup>2</sup> The Enterprise DG is currently reviewing the suggestions and recommendations. The HLGB identified several elements of the benchmarking process:

- High-level commitment to improvement:  
Identification and decision process for the target issue.
- Analytic support structure:  
Specific performance indicators (benchmarks).  
Analysis of world-wide best practice.  
Comparison of own practice against best practice.
- Improvement and learning mechanisms:  
Identification of potential for improvement.  
Implementation of changes.
- Monitoring mechanism:  
Reporting on progress made.

In a nutshell, benchmarking is a multi-layer strategy to achieve greater effectiveness and higher-quality services and encourage change. High-level commitment by top management or policy actors is needed to overcome resistance and to back the activities. In the Commission Services, benchmarking relates to policy objectives and is therefore to be understood as a tool to assist policy making. Benchmarking involves different elements and procedural steps. It is supported by research that establishes quantitative indicators and qualitative analysis of best practice. It indicates performance levels as well as the target to be achieved. Best practice demonstrates how the target is achieved. The display of best practice can inspire those who have fallen behind and serves as a learning opportunity for those who wish to improve their performance and to approach – or even exceed – the benchmark.

As understood by the HLGB, benchmarking can be described as:

- *Normative*: It provides an orientation towards leading-edge practice.
- *Analytic*: It develops key indicators and helps to understand why and how best practice has been achieved.
- *Action-related*: It aims at improvement and change.
- *Continuous learning*: It raises awareness about performance gaps, suggests ways to fill them and stimulates a continuous improvement process.

Benchmarking is not a short-term instrument for cutting costs. If innovation and economic development are to be encouraged, it is necessary to overcome entrenched approaches so as to find rational solutions in the search for best practices.

Indeed, benchmarking presupposes that all the societal actors involved in the process of change have shared objectives and values. It has to serve as a tool to build the consensus that is fundamental to initiating and sustaining change. Such consensus may be necessary to encourage mobility or new forms of organisation in enterprises or the public sector, for example to solve environmental and transport questions. Partnership and consensus of all the concerned actors builds the capacity to adapt to circumstances and to utilise the full potential of those involved.

Benchmarking can help governments to identify and track the world's most effective framework conditions for achieving high economic and social performance. It can provide effective tools for informing and guiding policy in the setting and reviewing of key framework policies.

## **History of benchmarking**

The idea of benchmarking was probably first applied in Japanese industry. After World War II, big enterprises wished to become world leaders. They decided not to invent but to copy and make incremental changes. Being pragmatic, they chose the world leader in their field as a reference point. Then their firms copied products, analysed production processes and incrementally improved the products and processes. This strategy was very successful in sectors such as automobiles, electronics and machine tools.

As a management tool, modern benchmarking was developed in the United States. Rank Xerox began internal benchmarking in its multinational branches in the early 1980s. It learned that its Fuji Xerox branch had only half of the costs of the US branch and was growing at a much faster pace, so that a rapidly widening gap in business development was apparent. This observation led to a careful evaluation of the reasons for this situation and eventually to actions to close the gap. It took some time to understand that the reason for the differences in growth were not cost advantages but more efficient production and product development procedures.

There later emerged other types of benchmarking, such as competitive benchmarking, inter-industry benchmarking, functional benchmarking, business process benchmarking, etc.

In the 1990s, regions like Australia or New Zealand used benchmarking for regional policies, such as improvement of the economic environment for harbours, rail transport, coal shipping, etc. In Europe, the United Kingdom applied early benchmarking techniques in the public sector, for customs and excise. In 1997, the Netherlands issued Benchmarking the Netherlands, a report on the whole nation; Denmark and Finland later followed.

There is huge potential for organisational improvements in Europe's public sector. Over the years, benchmarking has proven to be an efficient tool for improvement and organisational learning. For instance, the United Kingdom's VAT Central Unit at HM Customs and Excise estimates annual savings of the order of GBP 10 million from using benchmarking for organisational improvements.

Benchmarking has been carried out for home-care institutions in the Netherlands, quality management projects in the social services in Lower Saxony, in Swedish hospitals and in schools in the United Kingdom and in higher education in Sweden. At local level, benchmarking has even been carried out for opera houses.

In 1996, the Irish Presidency called on the Commission to develop benchmarking for the European Union.

## **Competitiveness and benchmarking in the EU**

According to a Benchmarking Communication of 1996,<sup>3</sup> benchmarking has great potential:

*“Competitive analysis identifies gaps in performance on key dimensions such as productivity, growth, costs, investment and innovation. However, competitive analysis does little to explain why these differences of performance have occurred and, in some cases, remain for many years in spite of widespread access to new technologies, capital and skilled human resources among developed countries. Benchmarking goes beyond competitive analysis by providing an understanding of the processes that create superior performance. It first identifies the key areas that need to be benchmarked and the appropriate criteria on which to evaluate that area. It then sets out to identify best practices world-wide and to measure how those results have been achieved.”*

In this communication and in DG III's 1996 Competitiveness Report, the objective of competitiveness was understood to be to increase the standard of living. The standard of living was defined as a composition of several factors, such as employment rate, productivity of economic actors and quality of products and services. This concept implies that framework conditions influence industry's economic performance. Framework conditions are also shaped by policies not defined by DG Industry. Therefore, benchmarking undertaken by other policy-making departments would be of interest for competitiveness policy.

The Enterprise DG understands benchmarking as a method and a tool that helps to set targets and guide improvements in the direction of greater effectiveness and quality in economic activities. Consequently, it has developed a number of activities.

## **Benchmarking in the former DG Industry<sup>4</sup>**

The industry department's benchmarking activities had two starting points: first, from the perspective of companies, European Quality Policy (called company benchmarking); second, the Competitiveness Report from a macroeconomic perspective (called benchmarking of framework conditions).

### ***Framework conditions***

Following a Council request, DG III started pilot projects in benchmarking framework conditions for industry. At a later stage, the Industry Commissioner called on the HLGB to advise him on benchmarking. The objective of the Commission's initiative to benchmark framework conditions was to provide an instrument for evaluating the efficiency of public policies and for identifying steps to improve them by reference to worldwide best practice. This initiative has involved a novel form of inter-governmental co-operation at European level with one Member State taking the lead role in the implementation of each project.

Four projects on benchmarking of framework conditions have been completed: financing of innovation (lead country: Denmark); information and communications technologies and organisational change (lead country: Finland); skills (lead country: Spain); and logistics (lead country: Ireland). This last project had good co-operation with DG VII. A further project, dealing with licensing procedures for businesses (lead country: Austria), was launched in December 1998. Follow-up projects to the four original pilot projects are being considered by Member States, particularly in relation to industry-research relationships (Austria), information and communications technologies and skills (Finland) and supply chains.

### ***Enterprise benchmarking***

At company level, benchmarking is a tool for supporting management strategies oriented to continuous improvement through identification and adaptation of best practices at process, organisation and management level and thus to increased competitiveness. In this context, the Commission has explored two areas of intervention. The first relies on existing expertise and know-how in Europe to develop a structure for promoting company benchmarking across Europe. The second focuses on SMEs' needs and expectations with regard to the implementation of benchmarking. In this perspective, two projects were supported. The "Benchmarking for Success" project identified existing company benchmarking expertise and services with a view to developing a European Company Benchmarking Network. The "Quality and Benchmarking for SMEs" project has sought to promote the adoption of benchmarking among SMEs and to capitalise on existing networks of chambers of commerce in Europe to create an environment conducive to SMEs becoming part of the wider European Company Benchmarking Network.

### ***Sectoral benchmarking***

Sectoral benchmarking draws on the principles of both enterprise and framework conditions benchmarking. It constitutes an extension of enterprise benchmarking in that many of the same principles can be applied to the set of enterprises which make up an industry and for which similar types of best practice are fundamental to competitiveness. It applies the methods of framework conditions benchmarking in order to identify best practice in relation to the key structural factors that drive sectoral competitiveness.

Industry associations are undertaking a wide range of initiatives with DG III support. These include projects on energy prices and efficiency in the chemicals sector, flexible work organisation in the automobile sector, innovation in the biotechnology sector, subcontracting processes in the consumer electronics sector and procurement processes in the information and communications technologies sector. Further initiatives have been launched in the biotechnology, mechanical engineering and construction sectors.

The Enterprise DG is in the course of considering how to integrate the various activities into a coherent approach and into an activity programme, as requested by the Industry Council.

### **Benchmarking of framework conditions**

The philosophy and practice of benchmarking are roughly similar in different domains of application. However, there is an important difference in the feasibility of using benchmarking results in framework conditions. At European and often at national level the political power to implement

changes immediately in the direction of best policy practice is lacking. Therefore, the most important and original element in benchmarking best practice is to prepare the ground for implementation. Even more at European than at national level, “indirect implementation” is of the highest importance. This means preparing implementation by raising awareness of competitive gaps, the feasibility of better and best practice and the impact of not applying best practice.

At European level, benchmarking framework conditions for industrial competitiveness mainly means sharing information and communication among the levels that have to move towards best practice. The aim of all the activities is to reach agreement on salient issues, to organise the analytical preparatory work, to exchange information, to display best practice and to foster competition among the actors in the implementation phase. The EU has therefore to convince Community actors to apply best practice.

Only when agreement has been reached at the highest political level and decisions have been taken at Union level does the Commission have at its disposal the instruments for direct implementation. The EU can then act directly, not only through indirect information and communication activities. Some positive examples of direct implementation can already be observed in the EU in areas such as Single Market legislation or agreements on the Employment Pact.

### Benchmarking activities in the Commission Services

The HLGB asked DG III to prepare a report on benchmarking in the Commission Services<sup>5</sup> (i.e. the 24 Directorates General) in order to obtain an overview of benchmarking-type activities. The HLGB considers that benchmarking may address different policy objectives in different Commission Services. Independently of the area concerned, the benchmarking method may include different elements. The results of the report were helpful in advising the Commission’s new Enterprise DG on upgrading its competitiveness policy.

According to the internal report, elements of benchmarking are scattered throughout the Commission. Only a small number of benchmarking activities meet the demanding requirements of a full-fledged benchmarking activity as identified by the HLGB.

The review of the Commission activities reveals some contrasting approaches. Policy targets vary considerably depending on the mission of the different Commission services, but the different approaches may apply benchmarking-like instruments.

Three different types of benchmarking approaches have been identified: the *surveillance approach*, the *improvement approach* and the *learning approach*. These three approaches reflect the degree of Member States’ commitment to a Community policy and may indicate the maturity of the political consensus on segments of Community policies. Insofar as clear targets are agreed upon, a top-down approach such as the surveillance approach can be used. It is to be regarded as an instrument to seek compliance, at national or decentralised levels, with Community policies or regulations already agreed on.

The four elements of benchmarking (i.e. the level or dimension of action, not the steps) are:

1. Political commitment.
2. Analytical preparation.
3. Improvement and learning mechanisms.
4. Monitoring.

The surveillance approach takes a shortcut from decision to immediate implementation and therefore concentrates on elements (1) and (4) above.

In contrast, the learning approach concentrates on elements (2) and (3). It is concerned with the question of how best to implement actions. It works from the bottom up to prepare or initiate policy action and is aimed at raising awareness of gaps in performance and in how these may be narrowed through best practice. The analysis of problems, comparative assessment, identification and working out of best practice are at a preparatory stage. Under this approach, activities prepare and establish the basis for political consensus on actions to be taken jointly at Community level. The exchange of good or best practice is already the starting point for improvement and learning at a decentralised level. However, this approach needs support and even enforcement to gather momentum.

The improvement approach can be assessed as intermediate between these two approaches. It embraces all four elements of a benchmarking activity and has as its basis a sustainable, comprehensive learning and improvement exercise. The improvement approach is well placed in the European Union's multinational and multicultural environment. It is well suited to policy which aims at voluntary adaptation to best practice in economic behaviour instead of central legislation and regulation. It may seek high European economic performance by accepting the uniqueness of regional or national origins. It could render the overall competitive situation more transparent by offering means of self-evaluation and learning possibilities for improvement and adaptation.

## **Recommendations of the HLGB for benchmarking in the EU**

Concerning the implementation and application of benchmarking in the Commission, the HLGB made the following recommendations.<sup>6</sup> A benchmarking activity will only be successful if high-level backing is given. Benchmarking requires analytical capacity. It also has to apply appropriate improvement mechanisms that vary according to the implementation conditions. Eventually, benchmarking has to monitor progress of implantation and improvement.

### ***Recommendation: Aim at a high-level commitment for joint action in the Councils***

A first step in carrying out a benchmarking activity is to gain the Councils' formal commitment to implementing the results through joint activities. These activities would have to be part of an action programme that considers all the essential elements of benchmarking, i.e. analytical capacity, improvement mechanisms, and monitoring capacity. Benchmarking activities are resource-intensive. Definition and implementation require the involvement of many actors. The necessary resources have to be defined and presented at the outset and require the backing of the highest decision makers.

### ***Recommendation: Improve analytical and co-ordination capacity by an “observatory” and allocate threshold resources***

An Observatory on Competitiveness would aim to monitor industrial, economic, societal and institutional developments in Europe in a transparent manner. The observatory should have a light structure and serve to provide analysis, benchmarking co-ordination and a dialogue platform with Member States. It should serve as platform for information and communication between the Commission and the Member States.

***Recommendation: Enforce improvement and learning mechanisms between Member States and the Commission***

A “peer group process” should be established to enforce the implementation and learning mechanisms of best practice in Member States. A “best practice host” would teach peers from other countries. The “learning peer” would consider how best practice could be transferred and implemented under his country’s particular conditions. The Industry Council should agree on a peer group implementation review that orients the EU, the Member States and industrial actors towards worldwide best practice in economic activities and that considers the implementation of best practice in the respective Member States.

***Recommendation: Initiate a monitoring process by joint progress reporting on the implementation of benchmarking activities***

Several DGs issue analytical reports. However, no reporting system tracks changes resulting from implementing policy actions due to benchmarking in Member States. A joint report from the Commission and the Member States comparable to the Joint Employment Report would be essential. In the case of competitiveness, a joint competitiveness report would be needed to monitor annual progress in the implementation of policies directed towards greater competitiveness in each Member State.

**Visit the European Benchmarking Web site**

The European Benchmarking Web site (<http://www.benchmarking-in-europe.com>) is part of the benchmarking initiative. The Enterprise DG has supported the setting up of a dedicated benchmarking Web site as a means of communicating information about benchmarking widely. This site currently averages 23 500 “hits” per month. It serves to inform a broad audience about all activities going on in the European Union.

## **NOTES**

1. The views contained in this paper are those of the author and do not necessarily reflect those of his institution.
2. "Final report of the High Level Group on Benchmarking", Brussels, October 1999.
3. European Commission, COM(96) 463 final.
4. This section refers to DG III (as well as other DGs identified by their Roman numerals). DG III refers to the DG Industry, which was responsible at the time for the activities discussed and is now, as of October 1999, the Enterprise DG.
5. European Commission, DG III, "Benchmarking in the Commission Services", Brussels, August 1999.
6. These recommendations concern the methodology and application of benchmarking. The author has removed elements that are specific to the Enterprise DG.



## **2. BENCHMARKING IN TRANSPORT**

*by*

**Gunnar Bärlund  
Finnish Railways VR, Finland**

*“It isn’t that they can’t see the solution.  
It is that they can’t see the problem”  
G. K. Chesterton*

In road and especially in railway transport, benchmarking has always been practised. The railway sector has developed sophisticated statistics covering most of a railway company’s activities as well as an infrastructure manager. Statistical figures for railway enterprises of different countries are often compared. Until recently, the word “benchmarking” was not used, and the activity was perhaps not sufficiently thought out. We may not have adequately considered what to benchmark, and we have definitely not sufficiently pondered why. One could say that the problem has been that the problems which benchmarking should solve have not been clearly enough sorted out. There is an unachieved goal behind every real problem.

This report is an effort, first, to answer the question “why”. Once we have clarified why we benchmark, it is much easier to define what and how to benchmark.

### **Definitions**

As the definitions of several words used in this area vary, it may be helpful to consider the most important ones here.

Within the transport sector, ***transport policy*** is the process of defining goals, carrying out measures to achieve the goals and checking whether the goals are achieved. Policy always includes several goals, some of which conflict with others.

The ***Common Transport Policy*** (CTP) is a transport policy which is commonly agreed and to which all relevant parties are committed.

A ***goal*** or an ***objective*** is an ideal (desired) situation, stage or quality, towards which one strives by one’s activities, but which one cannot necessarily fully reach. A ***transport policy goal*** may be a goal in any sector of society which may be affected (intentionally or not) by the activities of the transport sector.

An *interim target*, or a *performance target*, or a *stage target*, is a concrete and measurable target on the path towards a goal and which one has realistic possibilities of achieving (*i.e.* with a clear definition of the quantity and quality of the target, of the resources needed/available and of the time schedule).

One chooses a *means* or an *instrument*, or one carries out one or several *measures* to achieve the targets and the goals.

A **benchmark** (or, why not, *criterion of success*) is a standard in figures or a verbal description which makes it possible to compare the results of activities with the goals defined, or to compare one's activities with those of competitors, supposing that the competitor's goals are the same. At EU level, "best practice" is what comes closest to the goals of the CTP. The benchmark is an indicator showing to what extent one achieves the interim targets and the goals that have been defined.

### Benchmarking as part of the management of the transport sector

A commercial company uses benchmarking in order to improve its performance and to outstrip its competitors. Benchmarking is an intrinsic part of the management of an enterprise. The manager of a commercial company need not publicly discuss the benchmarking of his enterprise, except in general terms.

For the transport sector, at EU and Member State level (*i.e.* public authority level), benchmarking implies measuring the performance of the transport sector and comparing the results with fixed points or standards, *i.e.* the goals or the interim targets of the Common Transport Policy. As it is not clear who is the competitor of the DG VII or a national government, it is better to concentrate here on benchmarking as a tool for monitoring the achievement of CTP goals.

The public sector has often adopted theories and methods (economic models, management by objectives, introduction of competition/market forces, etc.) which have been developed for the private sector. This is analogous, however, to applying the principles of Euclidean geometry to solid geometry. When the dimensions of the problem increase, theories require modification. This is true for benchmarking in the transport sector and the entire transport system.

Public authorities use benchmarking in developing a European multimodal transport system consisting of a road system, a railway transport system, a waterway system and an air transport system, including linking nodes in the form of terminals and ports and a telecommunications system. The intention is to reach the goals of the Common Transport Policy. The Pan-European Transport System cannot necessarily be treated like a private commercial enterprise, nor can single national transport modes.

A national railway transport enterprise is very complex. Because its productivity and efficiency depend on geographical and climatic factors, demographic structure and the location of industry, differences in culture and national administration and in statistical definitions, one should not draw conclusions from an international comparison of benchmarks for railway undertakings. The same is true for infrastructure managers. However, this should not prevent the benchmarking of enterprises against themselves, as one may examine how they move towards achieving their policy goals by comparing benchmarks for different points of time.

Benchmarking is an intrinsic part of the transport policy process (see the contribution by Richard Deiss in this volume). The aim is to ensure that the European transport system develops in the

right directions, *i.e.* towards the goals of the Common Transport Policy. The performance of the transport sector should therefore be measured with respect to meeting these goals. There should be no other criteria or benchmarks.

Benchmarking requires defining general goals (European Commission, 1992; 1997; 1998a) more precisely so that they can be measured and there is a realistic chance of approaching them. In other words, interim or stage targets should be derived from relevant CTP goals, something public authorities may not yet have addressed sufficiently. Stage targets and indicators/benchmarks for the railway transport sector should be derived in co-operation with the CER (Community of European Railways).

If an objective or stage target cannot be measured in figures, one has to be content with measurement in words, or verbal benchmarks. However, when assessing the value of a measure or activity, it is necessary to take into account all the goals or interim targets that can be influenced by that particular measure.

## The management process

It is the task of the European Commission's Transport Directorate (DG VII) to manage the European transport policy process (and it is the task of ministries of transport to manage the national transport policy processes). This involves planning and carrying out the activities of the Commission and governments in the transport sector and monitoring the results. The Commission appears to use the following process in developing policy for the transport sector (Figure 1):

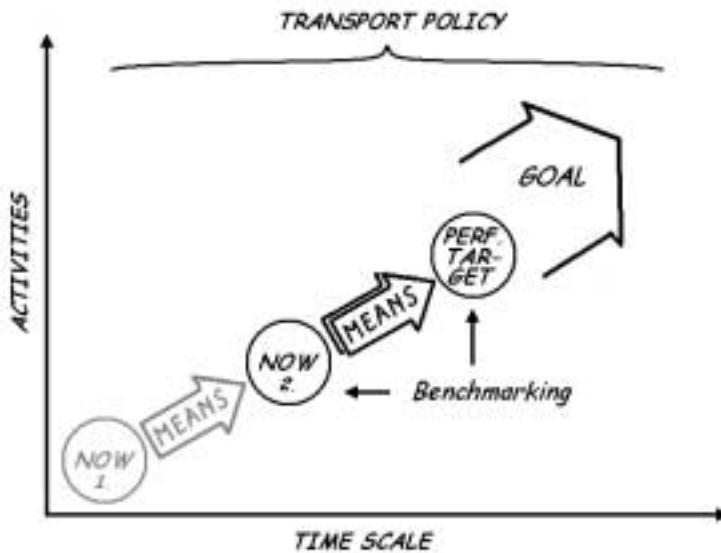
- Definition of (policy) goals.
- Execution of required measures (including definition of interim targets or stage targets).
- Evaluation of results (benchmarking) in achieving the goals.
- Redefinition of goals (if necessary).
- Execution of required measures.
- Evaluation of results (benchmarking) in achieving the goals.
- Etc. (a continuing process).

## Examples of benchmarking at EU or national level

There seem to be over a dozen strategic EU R&D transport projects which deal with various aspects of transport policy (ASTRA, COMMUTE, COST, ECONOMETRIST, ECOPAC, EUNET-SASI, EUROTOLL, FANTASIE, INFOSTAT, MINIMISE, PETS, POSSUM, PRORATA, QUILTS, SAMI, SCENARIOS, SORT-IT; see <<http://www.lu/transport/src/strat.htm>>). Even if the word "benchmark" does not appear in the summary of the objectives of these projects, they all deal with benchmarking to some extent. It is obvious that the transport policy process needs more conscious and systematic benchmarking.

Samples of benchmarks for the transport sector based on ideas presented in the final report of the EU R&D project POSSUM (European Commission, 1998b), and in the study "Indicators for the General Targets of the Transport System" commissioned by the Finnish Ministry of Transport and Communications (Pesonen *et al.*, 1998), and also in the proposal of the Swedish government, "Transport Policy for a Sustainable Development" (Swedish Government, 1997) are briefly described below. Information on the extent to which benchmarking has consciously been made use of at national level was not available.

Figure 1. A schematic presentation of the transport policy process



The most important goals of the Common Transport Policy (European Commission, 1992; 1997; 1998a) are listed below. The list gives a rough idea of the significance of the goals and of the relation between the various goals or activities in what is a very complex hierarchy:

- Sustainable mobility/development (i.e. minimum pollution, noise, accidents, and minimum necessary transport allied with a balanced economy and social welfare).
- Minimal pollution.
- Safety.
- Minimal use of resources.
- Employment and social protection.
- Decrease in regional differences.
- Efficiency of the transport system.
- A modal split which increases sustainable transport.
- Optimisation of the use of the infrastructure.
- Efficiency of transport organisations.
- Intermodality.
- Competition or introduction of market forces.
- Operators' intermodal competition.
- Level playing field.
- Infrastructure charging system.
- Transparency.
- Proportionality.
- Subsidiarity.
- Development of pan-European transport systems (i.e. ensuring possibilities for travel and transport).

The last four goals primarily represent principles (which have the properties of a goal, i.e. one tries to achieve them) that should be taken into account in every transport policy decision.

Interim target should be derived from the goals listed above and benchmarks should be defined in order to check attainment of these targets in the transport policy process. It is important to know the cause and effect relation between the different goals.

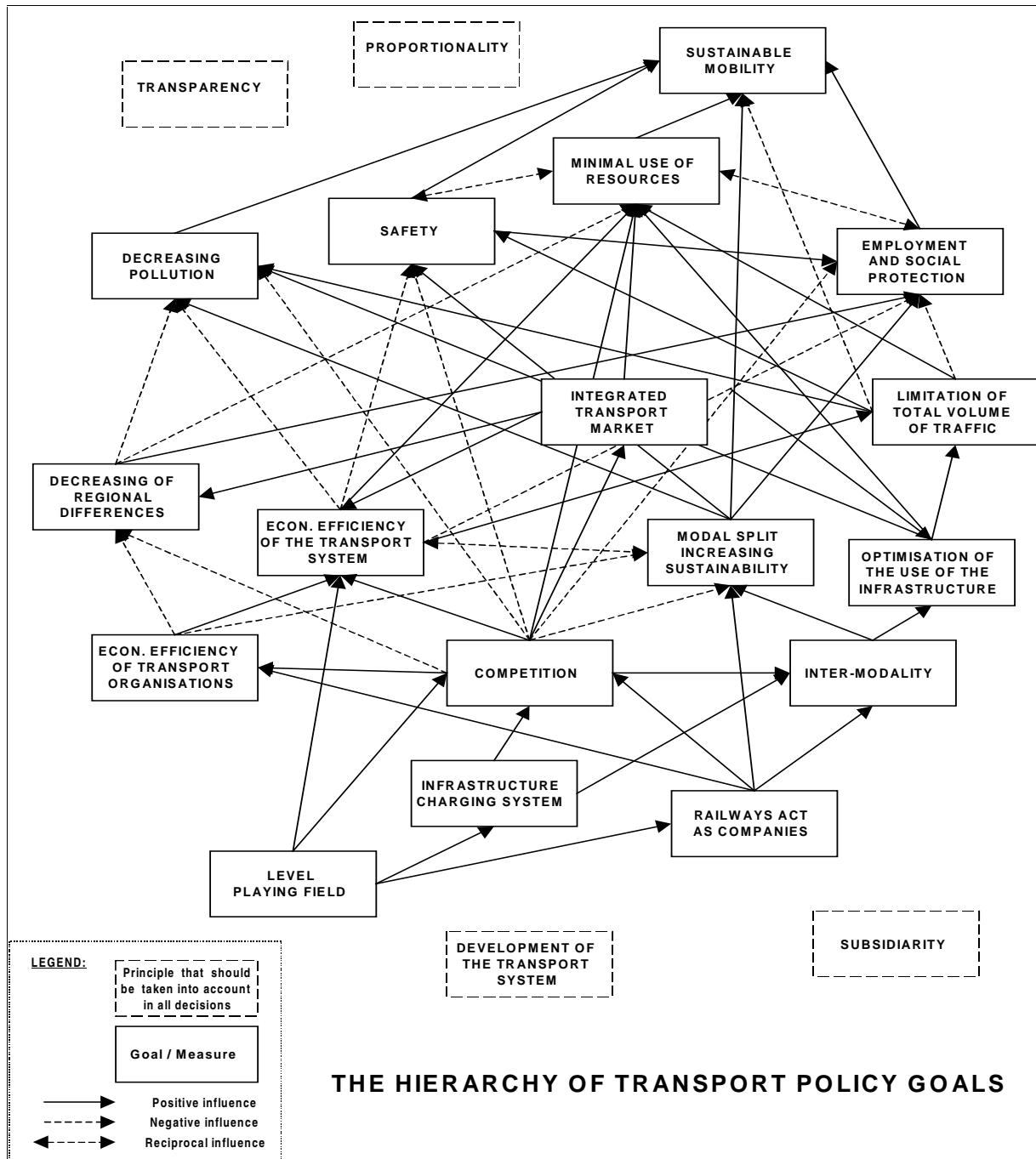
As other goals are attained, one approaches the ultimate goal of sustainability. An attempt to visualise the interdependence of the main goals of the CTP is given in Figure 2. It is ultimately the task of the public transport authorities to define the relevant goals and the interim targets. This is a political choice.

The Swedish government's Transport Policy Proposal (1997) (Table 1) has long-range goals and corresponding interim targets. As the table shows, no interim targets were found for the goals of accessibility and regional development. Therefore, it has not yet been possible to express any interim targets in figures, so that the existing situation and the target situation should be described verbally. However, accessibility can be benchmarked by mean time needed to reach terminals for public service, and regional development can, for example, be benchmarked by how people change residence or enterprises change location.

If it is not possible to give even a verbal description of the existing and the target situations, the goals of accessibility and regional development should be deleted from the list of the goals of the Common Transport Policy, since goals the achievement of which cannot be estimated are of no use.

Other interim targets in Table 1 seem clearly defined, and if they are realistic in relation to the resources needed, the corresponding indicators can be used as benchmarks for developing the transport system.

**Figure 2. An attempt to visualise the complexity of the hierarchy of the transport policy goals/measures of the CTP**



**Note:** The diagram does not claim to be exhaustive. It demonstrates the necessity of analysing which goal is the cause and which is the effect in order to choose the relevant criteria or benchmarks for a transport policy decision. The darts show the estimated causal connections between the different goals and measures.

**Source:** Gunnar Bärlund.

**Table 1. Long-term goals for the Swedish national transport system and corresponding interim targets**

Long-term goal	Interim target
<i>Accessibility:</i> The transport system corresponds to the need for mobility of citizens, industry and commerce.	One cannot define interim targets as the indicators are lacking. Methods and indicators have to be created to define the goal of accessibility and the monitoring of the achievement of the goal.
<i>Level of service:</i> The transport system offers a good level of service for industry and commerce.  Coverage and serviceability.	The extra social costs of lack of maintenance of road pavements must be eliminated.  Gravel roads are paved when it is social-cost effective.  The maximal axle load is increased from 22.5 to 25 t on lines with frequent and regular national transports.
<i>Safety:</i> In the long term, no one should die or be seriously injured by traffic accidents. The dimensioning and functioning of the transport system must adapt to the requirements of this goal.	By 2007 the number of deaths decreases to half the level in 1996.  Accidents in heavy commercial air traffic and private aviation are reduced by 50% between 1998 and 2007.  The number of serious accidents in merchant shipping decreases by 50% from 1998 to 2007. The target for fishing and leisure boating is the same.  No serious accidents occur in ferry traffic and other passenger traffic.  By 2007, the number of accidents at railway level crossings decreases by 50% from the 1996 level.
<i>Environment:</i> The transport system does not affect the right of citizens to a good and safe environment, where no damage is caused to the natural or cultural environment. Soil, water, energy and other natural resources are better controlled.	By 2010, CO <sub>2</sub> emissions reach the level of 1996.  By 2005, NOx emissions from traffic decrease by 40% from the 1995 level.  By 2005, sulphur emissions from traffic decrease by at least 15% from the 1995 level.  By 2005, volatile organic compounds (VOCs) from traffic emissions decrease by at least 60% from the 1995 level.
<i>Balanced regional development:</i> The transport system promotes positive regional development, partly by diminishing variations in the conditions for development of different parts of the country and partly by diminishing the inconvenience caused by long distances.	No interim targets can be defined, because no indicators suitable for measuring this goal have been found. Research to develop indicators showing the impact of infrastructure measures on regional development must continue.

Source: European Commission, 1998b.

The POSSUM Report (European Commission, 1998b) groups the goals in three main categories (Table 2). According to the report, “A choice was made early in the project to identify policy targets for the three main issues of environmental protection, economic efficiency and regional development, which coincide with the three main themes of current European Common Transport Policy.” The POSSUM report observes that one measure may serve several goals and targets:

*“Since social, economic and environmental impacts are often interrelated, many of the impacts in Table 3 could be included in more than one category. Accidents, for example, are listed as a social impact of transport, but they also have an impact on the economy in terms of health care, sickness benefits, etc. The goals of sustainable mobility, as outlined in the EU CTP can be summarised as: unimpeded movement of goods and persons; coherent, integrated transport systems; economic and social cohesion; environmental protection; safety promotion; social improvement; and the development of transport links to or from Europe. Potential indicators for the development of targets for each of these seven goals are presented in Table 3.”*

Table 2. POSSUM study: key domains, issues and potential indicators

Domain	Issues	Potential indicators
Social	Accessibility	Walking distances to local services/facilities
	Health	Report incidences of transport-related illnesses
	Safety	Number of poor air quality days
	Noise	Road accident rates (casualties and deaths)
	Visual intrusion	Proportion of population affected by noise
		Proportion of population affected by visual annoyance
Economic	Congestion	Road vehicle-kilometres/road length
	Building corrosion	NO <sub>2</sub> emissions
	Road/bridge damage	HGV vehicle-kilometres
Environmental	Resource depletion	Energy consumption
	Climate change	Loss of agricultural land
	Acidification	CO <sub>2</sub> emissions
	Air pollution	NO <sub>2</sub> emissions
	Waste generation	Emissions of NOx, VOCs, CO, etc.
	Water pollution	Vehicles scrapped related to vehicles recycled
		NO <sub>2</sub> emissions

Source: European Commission, 1998b.

Table 3. **POSSUM** study goals of sustainable mobility and potential indicators

Goals	Potential indicators
Unimpeded movement of persons and goods (accessibility)	Average trip length, access to public transport services
Coherent, integrated transport systems	Intermodality
Economic and social cohesion	Congestion, unemployment
Environmental protection	CO <sub>2</sub> , NOx, waste, fuel use, etc.
Safety promotion	Road accidents and deaths
Social improvement	Incidence of ill health (asthma, bronchitis, etc.)
Development of transport links to/from Europe	Number of passengers to/from Europe

Source: European Commission, 1998b.

The unimpeded movement of goods and persons is certainly a goal of the CTP, even if this is not explicitly mentioned in the documents containing the Common Transport Policy. Accessibility is thus a goal that could be benchmarked. Table 3 indicates that a coherent and integrated transport system is a goal. As a transport system already exists, the goal is defined in terms of qualities of the system, such as "coherence" and "intermodality". Achievement of these goals can be monitored, for example, by using the number of intermodal terminals or the number of travel centres (i.e. integrated railway stations) (see the contribution by Richard Deiss in this volume) as benchmarks for intermodality and the volume of technical standards for interoperability as a benchmark for the coherence of the European transport system. The number of traffic accidents and deaths is a benchmark that can be used to monitor the goal of traffic safety and has been so used for a long time.

The study commissioned by the Finnish Ministry of Transport and Communications (Pesonen *et al.*, 1998) points out that goals in other sectors of society can be achieved with the help of the transport sector. The key social policy areas are economy, regional and social equality, and environment and safety (Table 4). Key areas and goals for the transport system are defined for each key area of social policy. The results of this study, which focuses on national transport, do not appear to have been implemented so far.

**Table 4. Key social policy areas, derivation of key areas and goals for the Finnish transport system**

Key social policy areas	Key areas for the transport system	Goals for the transport system
Economy	Socio-economic efficiency	Necessary transport services are produced at minimal socio-economic costs.  The capital value of the traffic network is maintained so that the costs to society and users are optimised.
	Corporate economy (competitiveness, logistics)	The transport system ensures rational location of industry and commerce so as to support regional and municipal development and ensures development of the logistics to reinforce international competitiveness.
		Good operational conditions for national transport business are ensured in the home country, in the region and internationally by developing the transport system and international co-operation.
Regional and social equality	Regional equality of mobility	The transport system ensures the smooth running and reliability of freight traffic.
	Minimising disadvantages to the population	The transport system supports development of the regional and municipal structure.  Different parts of the country obtain the connections and transport services required by the regional and municipal structure.
		All population groups (age, sex, mobility, economic state, etc.) have the possibility to move and have access to basic services.
Environment and safety	Social equality of mobility	The number of deaths and injuries caused by traffic accidents is minimal, and the accidents clearly cost less than at present.  Health hazards caused by the transport system are minimal.
	Minimising disadvantages for the environment	Harmful impact on nature (organisms, vegetation, climate, water, soil, air, biodiversity) is minimal.
	Adjustment of the transport system to the constructed environment	The transport system contributes to achieving targets for regional and municipal structures, landscape, townscape, buildings and cultural heritage.
	Saving of natural resources	Minimal use of natural resources (energy, soil, land area, etc.).

Source: Pesonen *et al.*, 1998.

The study divides the goals of the transport system into a hierarchy of sub-goals. For each sub-goal, a large number of indicators are proposed, which can be used to follow up the development of the transport system. Table 5 presents a few indicators for each key area of the transport system.

**Table 5. Samples of indicators describing the state of and changes  
in the national transport system**

Key area of the transport system	Indicator <sup>1</sup>
Social economy	(12) Distance between production and distribution (21) Mean duration of public transport (congestion) (22) Mean duration of car trip (congestion) (66) Density of smart cards for collecting of public transport fares (85) Costs of pollution (139) Number of households and changes in their location (140) Changes in value of land area (148) Number of new enterprises (156) Substitution of physical accessibility by telecommunications (161) Direct and indirect consumption of energy
Corporate economy	(43) Ticket price (44) Price for freight (45) Congestion fees (61) Distances to terminals (85) Technical compatibility of equipment (87...95) Operating costs (113) Economic situation of the operator (116) Direct and indirect consumption of energy (131) Number of new enterprises (145) Taxation
Regional equality	Impact on land use (15) Accessibility to the regions expressed in travel and transport time (30) Substitution of physical accessibility by telecommunication (41) Regional costs of public transport (73) Earmarking of funds for different modes of traffic (87) Number of households having changed their location (91) Impact on local economic development (108) Regional distribution of accidents (131) Regional real-time information (telematics) (147) Level of use of public transport
Social equality	(16...19) Distribution of ticket prices on different population groups (30) Mean duration of trip by public transport (congestion) (41) Distribution of jobs on different population groups (47) Integration of transport modes (59) Services and equipment for disabled persons at terminals (70) Number of accidents in different population groups (79) Frequency of departures of public transport (98) Real-time information (106) Service level of public transport for different population groups (113...116) Exposure to pollution of different population groups
Impact on people	Number of accidents causing death per year and per capita Number of accidents causing injury per year and per capita (34) Number of inhabitants/workplaces/schools/kindergartens...within the noise area (40...43) Exposure to noise and pollution (44) Emission from road traffic (can be calculated with KEHAR programme) (50) Transport of dangerous goods (82...87) Quality of public transport vehicles (116) Service level of public transport (123...129) Satisfaction of road users (148) Days of congestion per year

**Table 5. Samples of indicators describing the state of and changes  
in the national transport system (continued)**

Key area of the transport system	Indicator <sup>1</sup>
Impact on nature	(5) Noise level in the vicinity of the road (12) NOx emission (15) CH <sub>4</sub> emission (16) Emissions of particles (17) Emissions of different traffic modes (28) Greenhouse effect of traffic CO <sub>2</sub> emission (34) Use of fossil fuel (42) Water pollution (75) Indicator showing decrease in traffic (76) Transport of dangerous goods
Impact on natural resources	(2) Polluting of ground water (4) Energy consumption caused by mobility (5) Energy consumption for infrastructure (6) Energy consumption for production of vehicles (9) Use of fossil fuel (17) Use of renewable energy sources (25) Land area in use for different modes of transport (30) Impact of traffic infrastructure on ecologically sensitive areas (35) Consumption of mineral aggregates (53) Indicator showing decrease in traffic
Impact on the constructed environment	(1) Loss of architectural objects (2) Loss of historical and archaeological objects (4) Impact on cultural environment (5...6) Visual impact on the landscape (10) Amount of pedestrian streets and car-less areas

1. The number of the indicator is indicated in brackets.

*Source:* Pesonen *et al.*, 1998.

### Benchmarking with reference to central and eastern Europe

The great majority (if not all) of the central and eastern European countries (CEEC) were represented at the Third Pan-European Transport Conference, which took place in Helsinki on 23-25 June 1997. The Declaration (European Commission, 1997) containing the definition of the Pan-European Transport Policy was approved and signed by all representatives of the participating governments and parliaments of the European countries, as well as by the representatives of the institutions of the European Union and of intergovernmental organisations and bodies, *e.g.* the United Nations Economic Commission for Europe (ECE), and the European Conference of Ministers of Transport (ECMT). The goals of this Pan-European Transport Policy should be included in the transport policies of every pan-European country. It seems that there are no real differences between the ultimate goals of the Pan-European Transport Policy and the EU Common Transport Policy. Thus, the selection of benchmarks for monitoring the attainment of transport policy goals at national and pan-European level in the CEEC countries is the same as for EU countries.

The CEEC countries seem to have problems connected with the quality of the environment and of infrastructure, the financing of the transport sector, the recent organisational restructuring of the sector, especially the railways, and the rapidly decreasing market share of environmentally friendly transport modes.

The restructuring of the transport sectors of CEEC countries seems to lag behind the development of the transport sector in EU countries. Thus, these countries have an even greater need for the definition of the Pan-European Transport System and its national components and for a geographically more precise definition of the networks of the international transport system, so that scarce funding can be used as efficiently as possible. In accordance with transport policy goals, it is necessary to concentrate on developing international transport systems. Thus, the first benchmark is definition of the national component of the pan-European transport system: Has the international transport system consisting of networks, nodes, information systems, standards for infrastructure and rolling stock and vehicles, and organisational structure been defined? Another benchmark to employ in the first stage would be the country's revitalisation of the railway sector: Have the necessary measures been made? Examples of other important benchmarks are: modal split, CO<sub>2</sub> emissions, efficiency of transport firms, and rate of return on transport investment. It is the task of national governments to choose the means to achieve and to benchmark transport policy goals.

## Conclusions

In a booklet published in 1996, the European Round Table of Industrialists (ERT) says that "benchmarking is a tool that many companies and some governments are already using with great success as a means to improve their performance" (ERT, 1996). They did not explicitly state that a government's performance in this respect means achieving the goals of the Common Transport Policy. But they did implicitly state that employment was (at that time) an important goal which can be benchmarked.

It is obvious that some clarification of the transport policy process is needed. It would be a good idea to stress the importance of following up the attainment of the goals of the CTP by giving the technical term "benchmarking" the meaning of measuring and comparing targets and achievements in transport policy. The benchmarking of the achievement of goals has been, to some extent, neglected. Transport research and development (EU Framework Programmes for R&D), should also be more consciously and systematically benchmarked.

In order to limit the task, the European Commission and the governments of the EU members and the CEEC countries could concentrate on developing Europe's transport system. National governments are responsible for developing their national transport systems, which are interconnected via the international transport system. However, what does Europe's transport system signify in terms of infrastructure networks, information and telecommunication systems, transport equipment, structure of transport organisations, laws and standards? Do the blueprints exist? The backbone of Europe's transport system consists in principle of the trans-European networks (TEN) for the different transport modes (TERFN for international rail freight), including the TEN for ports and TEN for telecommunications.

As the number of goals and targets within the transport sector is considerable, it would be advisable to proceed pragmatically, as was proposed in the POSSUM report (European Commission, 1998b). Some benchmarks should be chosen for permanent production for monitoring the development of the European transport system and others should be produced depending on which goals are estimated to be important at a given moment in a certain region or country of Europe.

A question for consideration is: Who among the different “stakeholders” in transport policy (political decision makers and public authorities at EU and national level, trade and industry, scientists, car drivers, citizens) is responsible for which aspects of the transport policy process, and how should benchmarking be taken care of? How should benchmarking be organised?

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### **3. BENCHMARKING EUROPEAN TRANSPORT**

*by*

**Richard Deiss<sup>1</sup>**  
**DG Transport, European Commission**

#### **Summary**

The large performance differences within the transport sector and between countries imply that transport still offers great potential for improvement. Furthermore, as a result of ongoing technological and organisational progress, this potential is continuously evolving. There are growing pressures from the economy and the transport industry, from environment and public finances to realise the potential for improvement in the transport sector.

This paper addresses benchmarking as a tool to identify and release the potential for improvement in the transport sector. Benchmarking aims at improving performance by identifying best performance and best practices, by analysing the reasons for performance differences and by preparing and implementing change. Transport benchmarking has to take into consideration the complexity and interaction between transport policy and general and specific driving forces behind transport demand and supply. Data availability and quality are often limiting factors for benchmarking at policy level.

Transport infrastructure, transport and environment and transport intermodality are used in this paper as examples of horizontal areas for transport benchmarking. A comparison and assessment of basic aspects of the transport system (transport intensity, modal split, productivity) in the EU, the United States and Japan is also provided. The comparison of transport in Europe, the United States and Japan and Singapore shows that the United States offers benchmarks in the field of freight transport (productivity and market share of rail freight), while Japan and Singapore provide passenger transport benchmarks (average transport distances, transport intensity, share of rail passenger transport and of public transport).

Examples of possible European benchmarks at country level are: the Netherlands (general efficiency of the freight transport sector, efficient utilisation of infrastructure, passenger intermodality, promotion of cycling, port hinterland traffic, inland navigation); Austria (modal share public transport, modal share railway passenger transport, infrastructure pricing, CO<sub>2</sub> emissions from transport); Sweden (road transport safety, port-hinterland container traffic by rail, modal share rail freight transport); the United Kingdom (road transport safety, efficiency of air transport sector); and Denmark (infrastructure quality).

## **Introduction: the concept of benchmarking**

Like other economic sectors, the transport sector is under permanent pressure to improve. Pressure for improvement comes from many sides: the economy (globalisation, competition, outsourcing); the environment (environmental pressures due to pollution, noise, land take, etc.); society (perception of problems, customer expectations); and public finances (scarcity of resources). Technological and scientific progress on the other hand continuously increases the possibilities for improving performance.

Benchmarking aims at improving performance by identifying best performance and the underlying best practices, by analysing the reasons for performance differences and by stimulating and orienting change. Benchmarking is a dynamic process of continuous improvement of performance through learning from others. Benchmarks are currently used to compare the performance of a company (and in some cases of sectors, regions and countries) with a reference standard of excellence for certain parameters. Benchmarks are derived from best performance of competitors (intra-sectoral benchmarking using sector-specific benchmarks) or from other economic sectors (inter-sector benchmarking).

In its Communication “Benchmarking the competitiveness of European industry” [COM (96) 463 final of 9 October 1996] and its follow-up “Benchmarking: implementation of an instrument available to economic actors and public authorities” [COM (97) 153 final of 16 April 1997], the Commission proposed using benchmarking in the economy and society to compare performance in different key areas and factors that determine economic success. The Communication suggested using benchmarking for “the comparison of societal behaviour, commercial practice, market structures and public institutions across countries, regions, sectors and enterprises in order to detect best practice, and to identify changes required to mobilise all actors of the economy and society to evolve in this direction”. As a tool for policy makers, benchmarking framework conditions has been specified as an approach for evaluating the efficiency of public policies, comparing factors such as costs, innovation and infrastructure. The Member States and the Commission have together set up pilot projects to benchmark the areas of innovation, information technologies, training and logistics.

Transport benchmarking projects carried out in the past covered only certain aspects of the European transport system. These projects addressed specific economic indicators such as costs and charges (e.g. airport charges) or specific modes (*e.g.* benchmarking of ports, airports) and compared the performance of certain countries.

Benchmarking at aggregate, international level faces considerable limitations as regards the availability, quality and comparability of statistical data. There are, however, efforts to improve data availability and quality at international level (Eurostat/ECMT/UN-ECE working groups). New methods to collect missing data in a cost-efficient way are also being developed under the Fourth and Fifth Framework Programmes for Research and Development in Europe.

This paper sets out the principles of benchmarking in transport and gives examples of transport benchmarks. Benchmarking is presented as a tool for assessing and improving the European transport system and its framework conditions. A main objective is to stimulate Member States and other interested actors at policy and market level to further develop and promote transport benchmarking as an instrument for improving the efficiency and sustainability of the European transport system.

## Benchmarking in transport

### *The importance of transport benchmarking*

There are considerable differences in transport quality and performance of modes and in the integration of modes within the Union and at global level. There thus appears to be considerable potential to improve the quality, efficiency and sustainability of transport in Europe as a whole. The economic importance of transport, its impact on the environment and its social dimension foster interest in exploiting this potential.

Worldwide liberalisation in trade of goods and services, growing economic exchange with other continents and regions and the importance of transport services for industrial production and trade also underline the need to organise European transport as efficiently and in as customer-oriented a way as possible to allow the European economy to compete successfully on world markets.

The scarcity of public resources implies a need to maximise the efficiency of public spending for transport. Transport represents 20% of public expenditure (infrastructure, subsidies, etc.; ca. EUR 150 billion in 1997) or 2% of the EU's GDP; about 1% (EUR 70 billion) of the EU's GDP is invested each year in transport infrastructure.

As a result of differences in efficiency and market orientation as well as in interoperability and interconnectivity, road and air transport are growing faster than the more environmentally friendly modes. This leads to imbalances in the transport system. Benchmarking can be used to assess the potential for enhancing intermodality and reducing friction costs [COM (97) 243 final, 29 May 1997] between different modes and thus for the promotion and better use of alternatives to unimodal transport services.

The external costs of transport (air pollution, noise and accidents; congestion not included) are estimated at 2% of the EU's GDP (this corresponds to EUR 140 billion in 1999) [Green Paper on Fair and Efficient Pricing, COM (95) 601]. Transport in the European Union currently represents 31% of final energy consumption, 26% of man-made CO<sub>2</sub> emissions [Communication on transport and CO<sub>2</sub>, COM (1998) 204 final, 31 March 1998] and 64% of NOx emissions.<sup>2</sup> About 45 000 persons are killed each year in transport and 1.7 million are injured. Transport is the main source of noise in urban areas. Ongoing technological progress in transport equipment, transport infrastructure and fuel as well as progress in the organisation of transport (logistics, supply chain management) create new opportunities for reducing the environmental impact of transport while improving its efficiency. Transport policies share responsibility for mitigating negative environmental and health effects by setting the framework conditions for optimal exploitation of the existing potential for improvement.

### *The benchmarking process*

From a policy point of view, transport benchmarking is a tool to assess the potential for improving the transport system and to develop and implement appropriate policies. Benchmarking as a dynamic, continuous and heuristic learning process includes feedback elements to align the approach and its different steps with the objectives and availability of information. Transport benchmarking also has to take into consideration the complexity of and interaction between transport policy and general and specific driving forces behind transport demand and supply.

The first five steps of the benchmarking process (Table 1) are covered here. The objective is to suggest how transport benchmarking might be developed in the EU, including examples for possible

benchmarks and action to ensure follow-up by main actors at policy (EU, national, regional, local) and market level (transport service providers, operators, customers) for a better exploitation of benchmarking as a tool for improving transport.

**Table 1. Main benchmarking steps**

- 
1. Identification of relevant objectives and areas
  2. Selection of relevant dimensions
  3. Identification of indicators and data needed
  4. Data collection, analysis and assessment
  5. Identification of benchmarks
  6. Analysis of reasons for performance differences
  7. Strategy development
  8. Implementation
  9. Monitoring of results
- 

*Source:* European Commission.

Transport benchmarking can be carried out from different perspectives: from an enterprise perspective or from a customer perspective; and it can take place at different levels: at policy level (regulatory framework, infrastructure provision) and at microeconomic or enterprise level (transport enterprises).

Benchmarking of transport policy measures aims at identifying the potential and possibilities for improving existing framework conditions for transport in order to increase the efficiency and sustainability of the transport system. At Community level, this strategy can be applied to complement the monitoring of the implementation of Community legislation in the Member States by demonstrating the potential for improving the transport system. Benchmarking at this level can also be used to stimulate the market orientation and efficiency of transport companies.

With a view to promoting sustainable mobility, particular attention should be paid to the competitiveness of environmentally friendly modes and their integration with other modes. Benchmarking can support companies and policy makers in finding strategies to increase the position of these modes in the transport market.

### ***Selection of indicators***

The selection of appropriate indicators is a crucial step in the benchmarking process. Indicators should be relevant and analytically sound, and corresponding statistical data have to be available. These data should comply with certain quality standards: they should be precise, comparable and as recent as possible.

In many cases, the availability of statistical data is currently a bottleneck for transport benchmarking. At international level, data on certain transport modes are often not available for all countries. Results at international level are also often not fully comparable due to differences in definitions and in the scope of data.

Consistent and comprehensive data sets are available at international level only for certain modes (railway transport, air transport, international maritime transport). For others, consistent data are not available for all EU and OECD countries. Data availability is very limited for private passenger transport, especially for non-motorised transport. As a result of the liberalisation and deregulation of transport, certain administratively collected data sets have disappeared in the recent past (e.g. road freight transport data collected by customs offices). Breaks in time series and data quality problems limit possibilities for analysing changes over time. The international comparability of results is another problem: definitions and the scope of data vary between countries. Structural and geographic differences also have to be taken into account. There are, however, efforts in Europe to harmonise statistical data on transport at international level, including harmonisation of data within the EU by Eurostat and harmonisation within Europe by the Statistical Working Group UN-ECE, ECMT and Eurostat.

Benchmarking transport at aggregate level should take into account the fact that simple quantitative indicators do not always fully reflect the complexity of and the interrelationship between transport policy and other framework conditions for transport and the transport market, or between transport supply and demand in general. In many cases, meaningful benchmarks cannot be derived from such indicators. When comparing results at the level of countries, indicators should be selected that filter out structural differences between countries such as size, population and topography. Absolute figures (total transport performance, total transport emissions, etc.) therefore cannot be used for transport benchmarking. In many cases, simple relative figures (one data set divided by another, for example transport performance per capita or modal split) are also insufficient because they do not filter out differences in spatial structures and levels of economic development. Indicators for benchmarking transport at aggregate level should in theory be based on at least three juxtaposed data sets. Transport performance per capita should for example be related to economic output (transport performance per capita adjusted to economic output per capita expressed in purchasing power parities) or to the change of the modal split over time (modal shift to certain modes as an indicator benchmark).

The more data sets are related to one another, the better structural differences are filtered out. However, the clarity of the resulting indicators decreases and data availability problems increase as indicators become more complex. Accordingly, a compromise needs to be found for each indicator, depending on data availability.

## **Benchmarks for European transport**

### *Areas for transport benchmarking*

The different modes form a transport system and the performance of modes and their market share are more and more interlinked. There is also a strong relationship between spatial and economic structures and transport demand patterns. At aggregate (Member State) level, transport should be benchmarked in a horizontal, holistic way. In this paper, four horizontal areas are selected for benchmarking European transport: the European transport system (demand aspects), transport infrastructure, the environmental impact of transport and intermodality. Efficiency aspects are benchmarked in addition for railway companies, airports and ports.

## ***The European transport system***

The relative transport intensity of an economy (transport per unit of economic output or per capita) and modal split are key parameters for describing, comparing and analysing transport systems at aggregate level.

In the industrialised world, three types of spatial and transport systems can be identified: the North American, the Japanese and the European. Key features of the different systems are:

**North America:** Low population density (country as a whole, urban areas), low fuel prices, high level of energy consumption, traffic-intensive spatial patterns, high traffic intensity, high motorisation. Passenger transport: high share of private car and air transport, low share of non-motorised and public transport. Freight transport: high share of railway transport (as a result of long average transport distances), low share of road transport.

**Japan, Singapore:** High population density, high fuel prices, low level of energy consumption, short transport distances, spatial patterns not transport-intensive, low private car motorisation. Passenger transport: high share of rail transport, high share of non-motorised transport. Freight transport: high share of road transport (as a result of short transport distances).

**Europe:** Medium population density, medium, but growing intensity of traffic, spatial structures and motorisation. Passenger transport: medium share of public transport. Freight transport: high share of road transport, low share of rail transport.

The North American and the Japanese system are two opposite types of transport systems. The European transport system is somewhere in between the two (although there is marked spatial diversity and considerable difference among countries). The Japanese system performs well as regards energy consumption and CO<sub>2</sub> emissions. However, it is closely related to the underlying spatial structures and therefore can only be considered as a benchmark for countries with a similar spatial structure (population density). In freight transport, the globalisation of traffic flows distorts the significance of data on traffic intensity within a given territory: statistics on traffic on a national territory do not reflect the transport intensity of geographically small, export-oriented economies.

## ***Transport intensity***

Freight transport intensity is strongly determined by the geographic size of an economic space. Average transport distances and transport intensity increase with the size of an economic area. Transport distances are much greater in the United States than in Europe or Japan. However, as economic interaction increasingly takes place across borders, distances are increasing in the EU (Table 2).

If the level of economic integration already achieved is taken into consideration, the European economy can still be viewed as considerably less transport-intensive than the US economy. However, relative transport intensity is greater than in Japan. The differences in transport intensity are more pronounced in freight transport than in passenger transport.

Concerning freight transport, the US economy is four times as transport-intensive as the European economy on a per capita basis. If tonne-km per unit of economic output (PPP adjusted) is compared, the difference is still 1:3. As regards freight transport, the Japanese economy is only half as traffic-intensive as the European economy. The picture changes, however, and the differences are

smaller, if global sea transport flows are taken into consideration. North America forms a bigger contiguous land mass than Europe or Japan (which is a group of islands) and the average distance to the coast is greater. The United States also has considerable resources within its boundaries, while the EU and Japan import most raw materials by sea. Nearly 30% of world sea traffic is therefore EU-related, more than 10% of traffic are flows to and from Japan, another 10% are US-related traffic flows.

**Table 2. Transport intensity, 1996**

	Passenger transport Passenger-km per person		Freight transport Inland modes		Tonne-km per person incl. domestic/intra-EU shipping	
	Passenger-km per person	Pkm <sup>1</sup> adjusted to economic output	Tonne-km per person	T-km <sup>1</sup> adjusted to economic output	Tonne-km per person	T-km adjusted to economic output
EU-15	12 200	12 200	4 200	4 200	7 200	7 200
– EU max. (Denmark)	15 500	18 400	6 700	6 900		
– EU min. (Greece)	8 900	8 100	1 600	1 800		
United States	23 100	16 000	18 300	12 700	20 600	14 300
Japan	10 400	8 700	2 600	2 100	4 500	3 800

1. Transport performance per capita divided by the economic output per capita in purchasing power parities (PPP) (EU=1).

*Source:* European Commission.

International differences in passenger transport intensity are smaller than in freight transport, because passenger transport is strongly determined by short-distance movements (like commuting), which bear little relation to the geographic size of an economy. The differences in per capita mobility are in part a result of spatial structures (density and distribution of population at country level, population density and distribution within urban areas) and relative transport prices. Transport prices and land use planning also influence the evolution of spatial structures at local level. Mobility per inhabitant in the United States is nearly twice as high as in Europe. Per unit of economic output the difference is, however, much smaller (EU:USA = 1:1.3). High motorisation, low prices for fuel and for passenger transport services, and transport-intensive spatial patterns explain the high passenger mobility in the United States. As in freight transport, Japan is the OECD economy with the lowest transport intensity.

The differences in relative transport intensity between EU countries are small. Data quality limits the possibilities for identifying benchmarks. According to available statistics, Germany, Belgium and Austria have the lowest relative passenger transport intensity in the EU.

### *Modal split: passenger transport*

About 85% of motorised land transport in the EU is private transport (car/motorcycle), 15% is public transport. The share of public (land) transport in the United States is only 4%. In Japan, on the other hand, public transport has a share of nearly 40%.

The share of public transport is related to population density (Table 3). Areas with high population density offer good conditions for public transport services and poor conditions for private car transport (congestion). This explains why the share of public transport is relatively high in densely populated countries like Japan. Other important factors are relative price levels for the operation of private cars and policies regarding the promotion and supply of public transport services. Low fuel prices have induced traffic-intensive spatial patterns in the United States. These spatial patterns offer better conditions for private car use than for public transport. In Japan, high fuel prices have contributed to maintain less traffic-intensive spatial patterns.

**Table 3. Passenger transport modal shares, 1995**  
passenger-km motorised land transport as a percentage

	Car/ motorcycle	Bus	Tram.metro	Railway
EU-15	85	8	0.9	6
– EU maximum	89 (Greece)	14 (Denmark)	1.7 (Austria)	10.7 (Austria)
– EU minimum	76 (Austria)	5 (France)	-	1.4 (Greece)
United States	96	3.6	0.3	0.4
Japan	61	8	2.5	29
OECD max.	United States	Denmark	Japan	United States
OECD min.	Japan	United States	-	Japan

Source: European Commission.

European spatial structures show great diversity among countries and regions. Average traffic intensity in Europe falls between the US and the Japanese level. As regards the modal share of public transport, Japan can be considered a benchmark. Austria is the EU country with the highest share of public transport. This is in part due to spatial structures, but is also a result of transport policy (promotion of public transport) and the population's environmental awareness.

There are also strong differences in the share of non-motorised transport: walking and cycling represent only 5% of trips in the United States but 30-35% of trips in Europe and a similar share in Japan. The Netherlands and Denmark are benchmarks for cycling, and the share of trips on foot is relatively high in southern Europe and in Japan (Box 1).

### **Box 1. Possible benchmarks for passenger transport**

#### **Railway transport**

**Indicator:** share of railways as a % of total pkm: EU: 6%.

European benchmarks: Austria: 11%, Switzerland 14%.

World benchmark: Japan 29%.

- *Structural reasons* (Japan): high population density, large population concentration on east coast corridor, bulk goods transported by coastal shipping, railway network oriented towards passenger transport, mentality of population.
- *Policy reasons*: Japan was the first country to open a high-speed line (Shinkansen), traditionally strong role of non-state-owned (“private”) rail lines, privatisation of state-owned railway company (JR) in the 1980s.

#### **Public transport (bus/coach/tram/metro)**

**Indicator:** share of public transport as a % of total pkm: EU: 9%.

European benchmark: Austria: 15%.

- *Structural reasons*. 20% of the Austrian population lives in Vienna (the share of public transport at city level grows with the size of the city, at country level it grows with the share of the population living in big cities).
- *Policy reasons*: promotion of public transport, each city > 100 000 inhabitants has a tram or a trolley bus system, public bus transport services also cover remote rural areas.
- *Other reasons*: environmental awareness of the population.

Source: European Commission.

#### **Modal split: freight transport**

Nearly 74% of EU inland freight traffic is by road. This compares to a modal share of road transport of only 30% in the United States. In Japan, the modal share of road freight transport is, however, greater than in Europe. The United States and Canada have a high modal share of rail traffic (Table 4).

**Table 4. Freight transport, modal shares, 1996**  
Percentage

	Road	Rail	Inland navigation	Pipeline
EU-15	73	14	7	5.5
– EU maximum	98 (Greece)	36 (Sweden)	40 (Netherlands)	14 (Austria)
– EU minimum	40 (Austria)	2 (Greece)	-	-
United States	30	41	11	19
Japan	92.5	7.5	0	0
OECD maximum	98 (Greece)	48 (Canada)	40 (Netherlands)	26 (Canada)
OECD minimum	21 (Canada)	2 (Greece)	-	-

*Share of short sea/coastal shipping (based on 5 modes): EU: 40%, Japan 41.5%, United States: 11%.*

Source: European Commission.

The modal split in freight transport is strongly determined by transport distances. The shorter the average transport distance, the greater the modal share of road transport. The longer the average transport distance, the greater, in general, the share of rail transport. If the impact of transport distances is filtered out, Austria and Sweden can be considered as European benchmarks for the modal share of rail freight transport (Box 2).

### **Box 2. Possible benchmarks for rail freight transport**

Rail freight transport as a percentage of inland (transport tonne-km) in 1996: EU: 14%.

Benchmarks within the EU: Sweden 36%, Austria: 34%, Finland: 27%.

Benchmarks outside the EU: USA: 41%, Canada: 48%.

Sweden is the country with the highest modal share of rail freight. Sweden has also the highest share of container port-hinterland traffic by rail (46% compared to an EU average of 18%) and the Swedish railways offer the lowest freight transport tariffs in the EU. If transport distances are considered, Austria also appears as a benchmark.

- *Structural reasons* for the good performance of rail freight in Sweden: long inland transport distances, high transport volume of captive goods (iron ore, wood), little importance of inland navigation and pipeline transport (modal shares thus based on two modes only); climate favouring rail over road transport.
- *Transport policy reasons* include liberalisation of the market; separation of infrastructure and operation already in 1988.

Source: European Commission.

The topography, the availability of inland waterways and the spatial distribution of production of and demand for petroleum products determine the modal share of inland navigation and pipeline transport. The number of modes available also has an impact on the modal share of each mode. If modal shares are used for benchmarking, the impact of average transport distances and of structural and geographic factors has to be taken into consideration.

The Netherlands has the highest share of inland waterway traffic of all OECD countries. If the growth of inland waterway traffic since 1980 is used to filter out the influence of topography and the availability of inland waterways, Austria (+31%), Germany (+8%) and to a lesser extent the Netherlands (+5%) appear as benchmarks. Inland waterway traffic stagnated or declined in all other European countries. In the United States, it increased over this period by 23%. The opening of the Main Danube Canal and the economic integration of central and eastern European countries into the European economy are reasons for the strong growth of inland waterway traffic in Austria.

### *Productivity*

Measured in tonne-km performed per person employed in the transport services sector, productivity in the US freight transport sector is much higher than in Europe (Table 5). Global freight transport productivity in EU-15 seems to be higher than in Japan. Productivity is strongly related to average transport distances, which are much longer in the United States than in Europe or Japan. Another factor is the modal split and the relative importance of bulk goods. Liquid bulk, especially, which is very significant in the United States, can be transported very efficiently. The United States

has a large volume of freight transport and a high modal share of rail, pipeline and inland water transport; these modes perform more tonne-km per person employed than road freight transport. Japan has little rail freight and no pipeline transport, and freight traffic is characterised by short-distance transport by light-goods vehicles (average length of a road haul in Japan: 50 kilometres, in EU: 100 kilometres).

**Table 5. Overall productivity freight transport (without air and sea transport), 1995**

	Persons employed in freight transport Millions	Transport performance Trillion tonne-km	Million t-km per person employed
EU-15	4.2	1.55	0.4
Japan	1.8	0.33	0.2
United States	2.4	4.8	2.0

*Source:* European Commission.

Productivity differences between the United States and Europe are relatively small in road, sea and air transport. However, there are strong differences in the productivity of railway companies.<sup>3</sup> The average transport distances and the relative importance of freight and passenger transport play an important role. Another relevant factor is the liberalisation of railway transport. The liberalisation of rail traffic (Staggers Act) has boosted US railway productivity since the 1980s. Measured in p-km + t-km per employee (for the limitations of this indicator see note 7) railway transport in the United States is 18 times as productive as in Europe. The Burlington Northern is the most efficient company: 600 billion tonne-km (rail freight traffic of EU-15: 220 billion t-km) are performed per year with a staff of only 44 000 persons. In Europe, the private EWS (United Kingdom) and the SJ (Sweden) are the most productive railway companies.

The productivity of US freight railways is reflected in low freight transport tariffs and revenues per tonne-km (EUR/1 000 t-km, 1996: United States: 13, EU: 45, Japan: 57). Low tariffs are one of the reasons for the high modal share and the strong growth of rail freight transport in the United States. If EU rail freight tariffs declined towards the Swedish level, the EU industry could save EUR 5 billion a year. The savings could in practice even be greater because a certain amount of the more expensive road freight transport could shift to rail.

There are also considerable differences in the productivity and efficiency of seaports and airports. North Sea ports in general show higher productivity than other European ports and consequently attract traffic from a vast hinterland. As regards container traffic, some Mediterranean ports also show a high level of efficiency, and their container traffic is growing strongly (e.g. Algeciras, Barcelona, Gioia Tauro). Further efficiency improvements in European ports could help to promote sea transport, especially short sea shipping and to avoid deviation of hinterland traffic caused by strong differences in productivity and customer orientation.

In air transport, a number of airports (e.g. medium-sized airports: Dublin, Vienna; large airports: Manchester, Schiphol) show a high level of efficiency as regards the management and organisation of air transport capacity. The strong growth of air transport and limitations as regards the expansion of airport facilities imply a growing need to exploit possibilities for better use of existing capacity.

## ***Transport infrastructure***

A number of benchmarking projects in different countries (e.g. the Netherlands, Australia and Denmark) have analysed the quality of the infrastructure network and transfer points. Due to bottlenecks and congestion and limited possibilities for extending existing networks, the efficient use of infrastructure and infrastructure management have become more and more important. Benchmarking infrastructure provision should go beyond transport supply and include economic aspects such as investment and maintenance costs in relation to transport demand as well as the relationship between supply and demand and the impact of transport such as safety, environmental effects and spatial development.

The provision of transport infrastructure is a prerequisite for transport services and an important framework condition for economic activities. The construction of transport infrastructure is a significant economic activity in itself: more than 1 million persons are directly employed in the construction and maintenance of transport infrastructure in the EU.

Decision No. 1692/96/EC of the European Parliament and of the Council of 23 July 1996<sup>4</sup> mentions, under Article 2, sustainability, safety, contribution to social and economic cohesion, inclusion of all modes, optimal use of existing capacities, interoperability, economic viability, geographic coverage and the capability of connection to other regions as goals which the trans-European network has to meet.

Intermodal integration, the availability of information suprastructure (e.g. telematics) and traffic-related aspects such as the relation between capacity and demand, speed and the availability of services in nodes are additional quality aspects of transport infrastructure. The Fourth Framework Programme for Research and Development project QUITs (Quality Indicators for Transport Systems) has established a framework for evaluating the global quality of the transport system (Box 3). The result of the evaluation is expressed in total cost of travel, which is the sum of travel time (and its value), direct costs and external costs. There are also research projects on transport telematics and Intelligent Transport Systems (ITS) in the Fourth and Fifth Framework Programmes which aim at better utilisation of existing infrastructure.

The relation between the supply of transport infrastructure and transport demand is a key aspect of transport infrastructure. The provision of infrastructure should on the one hand, be minimised for environmental and economic reasons and because new transport infrastructure can induce additional transport demand. Each year, 1% of European GDP (EUR 70 billion) is invested in transport infrastructure (to which maintenance costs have to be added). On the other hand, insufficient infrastructure can lead to congestion and thus to a negative environmental and economic impact.

The comparison with the United States and Japan shows that road traffic density in Europe is about 50% higher than in the United States but 20% lower than in Japan, mainly as a result of different spatial structures. It seems, on the other hand, that the European railway network is underutilised, as it has only one-eighth of the passenger traffic density of Japan and only one-eighth of the freight transport density of the United States. However, one must take into consideration the fact that a railway system like the European one, which has to cope with a mix of slow freight trains and fast passenger trains, has a lower maximum throughput than a system that has mainly freight traffic (United States) or mainly passenger traffic (Japan). The liberalisation of access to rail transport infrastructure, the promotion of combined transport and the integration of modes (intermodality) are currently key transport policies that aim at making better use of existing EU railway transport capacities.

### **Box 3. Quality aspects of transport infrastructure**

*General aspects:* Planning process (response to transport demand, participation of public)

    Accessibility (organisational, spatial), geographic coverage

    Integration within a mode, Interoperability

    Intermodal integration (links between modes, integration of systems)

    Availability of information systems

*Costs:* Investment costs  
Maintenance costs

*Traffic aspects:* Safety  
Speed (maximum and system speed)  
Capacity, capacity-demand relation, congestion  
Service availability (nodes)  
Demand management  
Pricing systems

*Environmental impact:* Noise  
Land take  
Water and soil pollution  
Fragmentation (habitat and nature)  
Visual intrusion and architectural quality (nodes)

*Source:* European Commission.

Countries with low population density normally have a high number of road-km per person and little congestion. However transport infrastructure is under-utilised and transport distances tend to be long. Small, densely populated countries are more likely to be affected by congestion. However, distances tend to be shorter and transport infrastructure is better utilised. Simple ratios like road infrastructure in kilometres/per person or per km<sup>2</sup> can therefore not be used to identify benchmarks in the field of infrastructure supply. Indicators like average travel time, speed, percentage of traffic affected by congestion and percentage of roads equipped with road pricing or intelligent transport information systems are better. Transport infrastructure benchmarking also has to consider the geographic, economic and behavioural context of infrastructure supply and management systems. However, data availability and comparability limit the possibilities for infrastructure benchmarking at an aggregated, international level (Box 4).

In order to support benchmarking and the identification of best practices in the field of efficient use of transport infrastructure, the Commission intends to carry out studies and set up a database on best practices worldwide as regards the efficient use of existing transport infrastructure. The database will also cover benchmarks and best practices concerning other quality criteria of transport infrastructure like the planning process, transport safety, transport information systems, infrastructure maintenance and environmental impact of transport infrastructure.

#### **Box 4. Examples of good practices in the field of efficient use of infrastructure**

**Singapore:** Transport system: road pricing, car licensing, public transport; despite high population density, there are no congestion problems in Singapore.

**Switzerland:** Project Bahn 2000: country-wide integration of public transport services instead of focusing on speed maxima.

**Japan:** Good utilisation of rail infrastructure. The Japanese rail network is mainly narrow gauge and only one-sixth the size of the European rail network; passenger transport performance is nevertheless 40% greater than in Europe (EU: 270 billion pkm, Japan: ca. 370 billion pkm).

**California:** Promotion of car pooling, special lanes for high occupancy vehicles. Vehicle occupancy in peak hour traffic is normally only 1.2 persons per car. The promotion of higher load factors can contribute to a better utilisation of existing road infrastructure.

Source: European Commission.

#### ***Transport and environment***

The Maastricht Treaty includes sustainable development as one of the European Union's objectives. Transport has a considerable environmental impact. External costs of air pollution and of noise from transport are estimated at EUR 40 billion a year or 0.6% of the EU's GDP. Transport is responsible for 63% of NOx, 66% of CO, 40% of VOC and 26% of CO<sub>2</sub> emissions and is a main source of noise in urban areas. Water and soil pollution, land take and fragmentation, visual intrusion and waste are other important environmental impacts of transport.

Transport intensity, modal split and the technical quality of transport equipment are key factors in the environmental impact of transport. Therefore, the basic approaches to mitigating the environmental impact of transport are reduction of transport intensity in economic growth, traffic avoidance, modal shift and technical improvements.

The responsibilities for the basic approaches are located at all administrative levels: at the level of the Union (e.g. technical standards for vehicles), the Member States, the regions and the municipalities (e.g. spatial and urban planning and traffic avoidance). Benchmarks and best practices should therefore be identified at all levels.

At international level, benchmarking the environmental impact of transport is hampered by the lack of comparable and consistent statistical information. However, activities have started to improve the availability of comparable data.

The Joint Transport-Environment Council of June 1998 invited the Commission "in conjunction with the European Environmental Agency, and taking account of work done in other international organisations and Member States, to develop a comprehensive set of indicators of the sustainability of transport". The EEA and the services of the Commission have prepared a provisional list of indicators on the environmental performance of transport. The indicators selected will be the basis for an annual report on transport and environment in the EU. A zero version was prepared in autumn 1999. Eurostat and the Directorate General for Transport are currently examining, in co-operation with Member States, the possibilities for improving the availability and quality of relevant statistical data on transport. Methodologies for collecting missing data in an efficient way are developed in the Fourth and Fifth Framework Research Programmes. Studies are also carried out to collect available information from Member States and other sources and to fill gaps via estimates.

The indicators being developed are an important base for benchmarking the environmental performance of transport in EU Member States. The Commission intends to set up an open database on best practices at all spatial levels in the field of transport and environment. Preparatory work for setting up a database on the eco-efficient organisation of freight transport has already started.

The research action COST 341, which is supported by the European Communities, will investigate the habitat fragmentation caused by construction and use of the transport networks in Europe. Best practice as regards methodologies, indicators, technical design and procedures for avoidance, mitigation and compensation of adverse effects on nature will be gathered in a handbook on best practice (Box 5).

### ***Intermodal freight transport***

While congestion on the road network is growing, inland waterways and rail still have spare capacity for the transport of freight: 10 million tonnes are currently transported per kilometre of motorway in the EU but only 4 million tonnes per kilometre of inland waterway and 1.3 million tonnes per kilometre of railway. In addition, passenger traffic volume on motorways represents over 20 million persons per year and kilometre compared to only 1.7 million passengers per year and kilometre on the railway network.

More efficient and balanced use of existing capacity throughout the European transport system is an important factor for improving the environmental sustainability of transport. The promotion of intermodality is thus an essential component of European transport policy.

The European Commission's Communication on intermodal transport [COM (97) 243 final, 29 May 1997] explains that "the objective is to develop a framework for an optimal integration of different modes so as to enable an efficient and cost-effective use of the transport system through seamless, customer-oriented door-to-door services whilst favouring competition between transport operators".

For intermodal transport, the framework conditions of the transport market play an important role. It is expected that liberalisation of railway traffic will help advance intermodality. At present, the industry considers that the quality of railway services often hinders the development of intermodal transport. New innovative operators entering the market could help to remove this bottleneck.

However, other factors, like the inertia of transport structures and the persistence of a mode-oriented perception of the transport market, also play a role. The Commission can help to overcome these problems by disseminating information on best practices and benchmarks in intermodal transport and thus promoting an improvement of the quality of intermodal transport services.

A joint EU/US Working Group on "Best Practices on Intermodality" was constituted in October 1997. The European Freight and Logistics Leaders Club has been asked to study best practices on intermodality. The shuttle train service between Cologne in Germany and Busto Arsizio in Italy was identified and analysed as an example of best practice on intermodality (good performance as regards timeliness, speed, efficiency at terminals and tracking and tracing) (Box 6).

The IQ (Intermodal Quality) project of the Fourth Framework Programme for Research and Development investigates the intermodal quality of networks and terminals.

## **Box 5. Examples of benchmarks as regards the promotion of non-motorised transport**

The promotion of non-motorised transport is an important element in a strategy for limiting the environmental impact of transport and for improving the quality of life in cities.

Passenger car traffic is responsible for nearly 50% of transport CO<sub>2</sub> emissions and for a large share of accidents, noise and congestion. About 50% of the 400 million passenger car movements per day in the EU are in the range of less than 6 kilometres. Per vehicle-km, these short car trips are more polluting and energy-consuming than long distance trips. About 1 kg CO<sub>2</sub> is emitted per short distance car movement. In the short distance range, there are few possibilities for a modal shift to public transport. However, distances of up to 5 kilometres are ideal for the bicycle (which is the fastest mode in this distance class).

The promotion of cycling and of non-motorised transport in general can help to stop and reverse the current modal shift from non-motorised and public transport to private car traffic. The provision of cycling infrastructure plays an important role (bicycle lanes, parking facilities). Transport planners have found that there is a strong relation between the share of cycling as a percentage of all trips and the length of bicycle lanes per inhabitant.

Traffic calming is another important factor. Bicycle- and pedestrian-friendly communities are those with a high quality of life for citizens. Strong differences in the modal share of cycling are an indicator of the great potential for bicycle traffic in many European countries and cities. At Member State level, the share of cycling varies between less than 1% and 27%, at city level between 0% and 40%. Benchmarking the promotion of non-motorised transport can help to identify best practice and to induce additional measures to promote cycling and walking and other forms of non-motorised transport.

### ***Benchmarks for the promotion of cycling***

Cycling as a percentage of all trips: EU: 5%

**EU benchmarks:** Netherlands: 27%, Denmark: 18%

The Netherlands has the highest share of cycling in all OECD countries. Denmark leads in bicycle-km per person. The difference in the modal share of cycling is even greater at city level. In Groningen, considered to be the leading bicycle city in industrialised countries, 39% of all trips and about every second vehicle trip are by bicycle. Copenhagen has the highest modal share of cycling in cities of over 1 million inhabitants: 20% of trips are made by bicycle compared to 1% or less in most other cities of this size. There is one bicycle per person in the Netherlands and in Denmark (EU average: 1 bicycle for 2 persons).

Cycling as a transport mode is actively promoted in the Netherlands and in Denmark. The Dutch transport ministry has set up a bicycle masterplan for the Netherlands that aims at increasing bicycle-person-km by 30% by 2010. Other countries that have set up a bicycle masterplan at national level to promote cycling are Finland and the United Kingdom.

There are outstanding bicycle cities in many Member States, which can serve as benchmarks at national level. Examples: *Belgium*: Hasselt; *Denmark*: Copenhagen and Nakskov; *Finland*: Oulu; *Germany*: Münster and Erlangen; *Greece*: Volos; *Italy*: Ferrara; *Netherlands*: Groningen and Delft; *Sweden*: Västerås; *United Kingdom*: York and Cambridge.

### ***Benchmarks outside the EU:***

The share of cycling is relatively high in Japan (14% of all trips). This has, however, less to do with good conditions for cycling than with congestion and lack of parking space for private cars. The modal combination bicycle and railway is important in Japan.

Although the share of bicycle trips is in general very low in the United States, there are some outstanding small (university) cities which actively promote cycling (infrastructure, legislation) and which have a relatively high share of cycling. Examples are Gainesville (Florida), Palo Alto and Davis (California).

*Source:* European Commission.

#### **Box 6. Possible benchmarks in the field of intermodal freight transport**

**Organisation of port hinterland traffic:** Rotterdam: lowest share of road in hinterland traffic in Europe, highest share of hinterland traffic by inland navigation.

**Sweden (railway transport):** 18% of port-hinterland container traffic in the EU is by rail. Sweden leads with 46%. Sweden also has the greatest development of the modal share of container hinterland traffic by rail: since 1992, it increased by 8% whereas the European average is a decline of 1%.

**Development of port hinterland traffic:** container traffic on the Rhine.

**Improvements of services and of infrastructure:** Italy.

**Transport costs of rail container traffic:** United States.

Source: European Commission.

#### **Intermodal passenger transport**

There are more than 1 billion passenger trips per day in the European Union. About 600 million are by car (400 million car movements), over 100 million are by public transport. Only a small part of public transport journeys are “door-to-door” trips. The quality of public transport services thus depends to a large extent on integration with other modes. Private transport also profits from integration with public transport: while the passenger car and other individual motorised modes have advantages when transport demand is weak, public transport can cope better with strong, focused transport flows. Many trips, especially those from the periphery to the centre, are a combination of diffuse and concentrated traffic, and the latter could be replaced by public transport). Non-motorised modes can only be used for short-distance movements and depend on combination with other modes for long distance trips; however, they are an important feeder for public transport. The integration of passenger transport modes contributes to providing alternatives to unimodal private car transport and to improving the overall quality of a transport system. Benchmarking passenger intermodality can help to promote the integration of modes and thus to stabilise the demand for public transport services and limit the growth of private car transport.

Whereas passenger transport in North America is mainly based on car and plane, many additional modes play a role in Europe (railway, local public transport, bicycles, water transport, etc.). The great number of modes and the variety of transport solutions in Europe suggest the existence of a multitude of good practices and solutions from which benchmarks can be drawn.

In the past, integration of private and public passenger transport modes focused on the provision of parking facilities for private cars at transport nodes like airports, railways and suburban public transport stations. Because such facilities are space-intensive, other solutions are more and more being sought. Considerable progress has been made in the recent past in providing the infrastructure for intermodal passenger transport: a growing number of airports are connected to the local and long distance railway network (e.g. Stockholm, Frankfurt, Amsterdam), and more links are under construction (e.g. Cologne, Hanover). The potential of the bicycle as a feeder for public transport and railway traffic is increasingly exploited: nearly 1 million bicycles are parked each day at railway stations in Europe, the number is growing and many bicycle centres are currently under construction or planned. As regards the integration of public transport modes, there are more and more good examples at local level (Box 7). A new trend is the use of dual-system light rail vehicles that can use the railway infrastructure and thus provide seamless transport services from the suburbs to the city centre (e.g. Karlsruhe).

## **Box 7. Possible benchmarks in the field of intermodal passenger transport**

### ***Integration of public transport modes in general***

*Switzerland:* The Bahn 2000 project: integration of all public transport modes into one system; the Easyride project: a single mobility card with integrated chip to provide automatic payment and replace until 2005 all other public transport tickets.

*Netherlands:* integrated timetables, single ticket for all public transport modes.

### ***Airports***

Integration of long distance and local rail transport services. Airports fully integrated into national railway system: *Netherlands:* Schiphol; *Switzerland:* Geneva and Zurich; *Germany:* Frankfurt; *Denmark:* Copenhagen.

### ***Railway stations***

#### ***Public transport:***

*Germany:* all major railway stations fully integrated into public transport; best examples: Munich, Frankfurt, Hamburg.

*Netherlands, Switzerland (e.g. Zurich) and Austria (Salzburg, Vienna)* also offer good examples of integration of rail transport and local public transport.

#### ***Bike & rail:***

*Netherlands:* 104 railway stations have bicycle parking centres, most of which are operated by Dutch railways and provide guarded parking, bicycle hire, repair and sales of bicycles and accessories. Also, 40% of railway passengers access railway station by bicycle.

*NorthRhine-Westfalia, Germany:* in 1995, the *Land* initiated “100 bicycle stations in NRW”. More than 20 bicycle centres have since been created at railway stations, the largest, in Münster, has a capacity of 3 000.

*Japan:* More than 6 000 bicycle garages at railway stations. A growing number are computerised or automated multi-storey structures and 3 million bicycles are parked each day at railway stations (1 million in the EU).

### ***Railway/local transport***

*Karlsruhe:* an extensive regional light rail system has been established at low cost: intermodal, dual-system light rail vehicles enable the urban tram/light rail system to use local railway lines and to connect urban transport with the hinterland.

Other cities are also developing tram/train systems: *Saarbrücken* (first line opened 1997), *Kassel* (local rail freight lines used by trams) and systems are planned in *Mulhouse, Aachen, Chemnitz, Valenciennes* and *Luxembourg*. There are also several examples of the use of disused railway lines for urban light rail systems in the United Kingdom (*Newcastle, Manchester*). A new system was put in service in 1999 in *Zwickau*, Germany. A regional diesel train uses inner-city tram lines to provide seamless connections between the hinterland and the city centre.

Source: European Commission.

Despite the improvements, there is still a potential for considerable progress. Technical progress continuously increases the potential for optimising the soft factors of intermodality. Along with multimodal terminals, the Green Paper on the Citizens' Network [COM (95) 691] identified co-ordinated timetables and through ticketing as the most important elements of an integrated system. Another important aspect is availability of and access to information on timetables and tariffs. There is financial support from the TEN-T budget for projects which improve links between TEN-T and local networks, especially for traffic management and information systems and for linking airports with the rail network. A call for proposals for large-scale projects to test and demonstrate the potential of innovations in intermodal transport, including tasks aimed at urban and interurban passenger transport, was launched in December 1997 under the Fourth Framework Programme for Research and Development. Projects that have started are EU-SPIRIT, SWITCH and INTERCEPT. They will run between 1998 and 2001 [COM (1998) 431 final]. The Commission also supports the UITP/POLIS project ELTIS ([www.eltis.org](http://www.eltis.org)), a large Internet database on best practice in passenger transport.

## **NOTES**

1. The views expressed in this paper are those of the author and may not be those of the European Commission.
2. DG VII/EUROSTAT, *EU Transport in Figures*, 1999.
3. Productivity comparisons are to a certain extent hampered by the fact that statistical data on employment of railway companies normally do not provide a breakdown between passenger and freight transport. Therefore, total employment has to be compared to total passenger and freight transport performance, so that a tonne-km is equal to a passenger-km (in terms of transport units per employee, freight transport productivity is higher than passenger transport productivity). Some Member countries have separated infrastructure from the operation of railway traffic. Measured in pkm and t-km per employee, productivity of companies doing rail transport alone is higher than that of integrated companies.
4. On community guidelines for the development of the trans-European transport network, see *Official Journal*, 9 September 1996, page 2.

**ANNEX 1**  
**Overview of possible transport benchmarks at aggregate level**

	Area	Indicator	Possible benchmark at country level
<b>Transport systems</b>	Transport intensity of economy	p-km + t-km per capita per unit of GDP	Japan
	Modal split passenger transport	Modal share of public transport	Japan EU: Austria
		Modal share cycling	Netherlands City level: Groningen
	Modal split freight transport	Modal share of rail versus road transport	Sweden
		Modal share of sea transport	Netherlands
	Productivity	Freight transport productivity	United States
		Rail freight	United States
		Inland navigation	United States, Netherlands
		Road freight	EU: Netherlands
		Air transport	EU: United Kingdom, Netherlands
<b>Transport infrastructure</b>	Efficient utilisation of infrastructure	Pkm per railway-km	Japan
		t-km per railway-km	EU: Netherlands United States
		Availability of lanes for high occupancy vehicles	California
	Infrastructure pricing schemes	% of infrastructure equipped with road pricing systems	Singapore Austria
	Infrastructure quality	Infrastructure quality perception (survey results)	Denmark
<b>Environmental impact of transport</b>	Emissions	CO <sub>2</sub> emissions per unit of GDP	Austria Switzerland
	Safety	Fatalities per road vehicle	United Kingdom, Sweden
<b>Intermodal transport</b>	Passenger intermodality	Modal integration at nodes, airports	Schiphol Airport
		Modal integration at nodes, bike & rail	Netherlands Japan
		Modal integration at nodes, public transport	Switzerland, Netherlands
	Freight intermodality	Port hinterland traffic (inland waterways)	Rotterdam
		Port-hinterland traffic (railways)	Sweden
		Intermodal services	Shuttle container train services between Germany and Italy

Source: European Commission.

## **ANNEX 2**

### **Ongoing transport benchmarking activities**

Benchmarking urban network of 15 cities, involving municipalities, transport operators and the Council of European Municipalities and Regions (CEMR/CCRE) has also been set up to evaluate the work. During 1998-99, the Commission worked with public authorities and operators that have expressed an interest in benchmarking. The project has two stages: performance assessment and detailed benchmarking. Following the involvement of 15 cities in the first pilot round of data collection and benchmarking, the exercise is expanded to 60 cities in 2000. A database on best practices as regards urban transport systems was launched on the Internet in July 1998 ([www.eltis.org](http://www.eltis.org)). The Commission will publish a handbook on benchmarking local public transport and ensure that a database of results is widely available. The Commission intends to encourage widespread use of this benchmarking exercise by public authorities and operators.

#### **Benchmarking logistics**

Benchmarking logistics was selected as one of four pilot benchmarking studies commissioned in 1997/98 by the Member States and the European Commission. The logistics benchmarking study was commissioned jointly by DG III and DG VIII, with the direct involvement of six EU Member States (Austria, Finland, Ireland, Italy, Portugal, Spain).

Important aims of the project were to demonstrate the feasibility of benchmarking the logistics function at European level, to identify key elements affecting the contribution of logistics services to EU competitiveness, including framework conditions, and to identify the central issues for policy makers in designing a more comprehensive initiative on logistics benchmarking. A detailed pilot survey was conducted covering three industrial sectors and five performance criteria. The pilot surveys showed that the approach adopted for benchmarking logistics was feasible and provided insight into appropriate methodologies for future surveys. The hypothesis that framework conditions are important and that European and Member State policies strongly influence them was generally confirmed. A final report was issued in September 1998.

#### **Development of environmental indicators**

The Joint Transport-Environment Council of June 1998 invited the Commission “in conjunction with the European Environmental Agency, and taking account of work done in other international organisations and Member States, to develop a comprehensive set of indicators on the sustainability of transport”. The EEA and the services of the Commission have prepared a provisional list of indicators on the environmental performance of transport. The indicators selected are the basis for an annual report on transport and environment in the EU. A first report was produced in autumn 1999. The Directorate General for Transport, together with Eurostat, is examining possibilities for improving the availability of transport-related parameters as an input for environmental statistics. Methodologies for collecting missing data efficiently are developed in the Fifth Framework Programme on Research and Development. Further studies are carried out in order to collect available information and fill gaps via estimates. The indicators developed can be used as a basis for benchmarking the environmental performance of transport in Europe.

**ANNEX 3**  
**Statistical data on European transport**

**1. Transport intensity, 1996**

	Passenger-km per person <sup>1</sup>	Passenger-km per person, <sup>1</sup> PPP adjusted	Tonne-km per person <sup>2</sup>	Tonne-km per person, <sup>2</sup> PPP adjusted
Belgium	11 100	9 800	4 900	4 300
Denmark	15 500	13 400	3 800	3 200
Germany	10 800	9 800	5 200	4 700
Greece	8 900	13 100	1 600	2 350
Spain	10 500	13 500	2 800	3 600
France	13 800	13 300	5 300	5 100
Ireland	14 100	14 800	1 700	1 800
Italy	14 300	13 800	4 100	3 900
Luxembourg	13 200	8 100	6 700	4 100
Netherlands	11 600	11 200	5 700	5 300
Austria	11 300	10 000	4 700	4 200
Portugal	12 900	18 400	1 500	2 200
Finland	12 300	12 900	6 500	6 900
Sweden	12 500	12 600	5 700	5 700
United Kingdom	12 100	12 300	3 000	3 100
<b>EU-15</b>	<b>12 200</b>	<b>12 200</b>	<b>4 200</b>	<b>4 200</b>

PPP= purchasing power parity.

1. Passenger-km data without air and non-motorised transport.

2. Tonne-km data without air and sea transport.

Source: European Commission.

**2. Passenger transport, modal shares  
(passenger-km, motorised land transport), 1995**

	Car/motorcycle		Bus		Tram.metro		Railway	
	%	Change 1990-95	%	Change 1990-95	%	Change 1990-95	%	Change 1990-95
Belgium	82.2	+0.3	11.1	+0.3	0.7	0	6.0	-0.5
Denmark	79.8	+0.7	13.7	+0.2	-	-	6.4	-0.9
Germany	84.1	+1.8	7.8	-0.8	1.0	-0.8	7.2	-0.1
Greece	74.2	+2.0	23.2	-0.7	0.8	-0.3	1.8	-0.9
Spain	85.0	+0.6	10.0	+0.4	1.1	-0.2	4.0	-0.8
France	86.6	+2.6	5.2	-0.6	1.1	-0.3	7.0	-1.9
Ireland	86.8	-1.0	10.5	+1.2	-	-	2.6	-0.3
Italy	82.3	+1.7	10.6	-1.3	0.6	0	6.5	-0.4
Luxembourg	87.3	-0.4	7.4	-1.3	-	-	5.3	+0.8
Netherlands	83.3	-1.3	8.1	+0.2	0.8	0	7.8	+1.1
Austria	76.0	-1.4	11.5	+0.9	1.7	+0.3	10.7	+0.1
Portugal	84.9	+4.2	10.7	-1.2	0.4	-0.4	3.9	-2.7
Finland	81.5	+0.5	12.8	-0.4	0.6	+0.1	5.1	-0.1
Sweden	84.2	-0.1	8.5	+0.1	1.4	-0.3	6.0	+0.4
United Kingdom	88.3	+0.7	6.5	-0.2	1.0	+0.1	4.3	-0.5
<b>EU-15</b>	<b>84.7</b>	<b>+1.6</b>	<b>8.3</b>		<b>0.9</b>	<b>-0.3</b>	<b>6.0</b>	<b>-0.7</b>

Source: European Commission.

### 3. Modal share of cycling, 1996

Member State	Cycling as a percentage of all trips	Member State	Cycling as a percentage of all trips
Netherlands	27	Italy	4
Denmark	18	France	3
Sweden	13	United Kingdom	2
Germany	10	Luxembourg	1.5
Belgium	10	Portugal	1
Finland	7	Greece	1
Ireland	7	Spain	1
Austria	5	EU	5

Source: European Commission.

### 4. Freight transport, modal shares (tonne-km), 1997

	Road		Rail		Inland navigation		Pipeline	
	%	Change 1992-97	%	Change 1992-97	%	Change 1992-97	%	Change 1992-97
Belgium	70.4	+ 4.3	14.6	-4.9	12.0	+0.2	3.0	+0.3
Denmark	73.1	- 3.3	8.1	-2.1	-	-	18.7	+5.5
Germany	67.1	+ 3.2	16.2	-1.5	13.8	-0.7	2.9	-1.1 <sup>1</sup>
Greece	98.1	+2.3	1.9	-2.3	-	-	-	-
Spain	84.2	-0.9	10.1	+0.6	-	-	5.6	+0.5
France	74.3	+3.0	16.9	-0.9	1.9	-0.8	6.9	-3.5
Ireland	91.3	+2.4	8.7	-2.2	-	-	-	-
Italy	85.1	-0.1	9.4	+0.2	0.1	+0.1	5.4	-0.2
Luxembourg	68.7	+4.6	20.5	-2.7	10.8	-1.9	-	-
Netherlands	47.1	-1.7	3.6	+0.2	43.0	+1.8	6.3	-0.5
Austria	39.2	-1.5	35.5	+0.4	5.2	+0.9	20.1	+0.2
Portugal	85.7	-1.6	14.3	+1.6	-	-	-	-
Finland	71.0	-3.9	27.6	+3.8	1.4	+0.1	-	-
Sweden	63.4	+7.5	36.6	-7.5	-	-	-	-
United Kingdom	84.3	+2.1	9.3	-1.0	0.1	0	6.2	-1.1
EU-15	73.1	+1.6	14.5	-0.8	7.2	-0.1	5.2	-0.6

Note: For reasons of comparability, modal split data for EU countries have been calculated on the basis of transport performance on the territory (tonne-km) of each country.

1. Result affected by a change in time series.

Source: European Commission.

## **5. Modal share of short-sea (intra-EU) shipping, 1996**

Member State	% of tonne-km	Member State	% of tonne-km
Greece	79	Spain	50
Finland	76	Netherlands	50
Ireland	66	Italy	42
Portugal	63	Sweden	38
United Kingdom	55	France	23
Belgium	53	Germany	17
Denmark	52	EU	41

*Source:* European Commission.

## **ANNEX 4**

## **1. Development of the Common Transport Policy: Key Policy Papers**

COM= Communication, GP = Green Paper, WP = White Paper

## 1. Development of the Common Transport Policy: Key Policy Papers *(continued)*

COM= Communication, GP = Green Paper, WP = White Paper

	1985-91	1992/93	1994	1995	1996	1997	1998	1998	1999
Infrastructure				GP: Fair and efficient pricing				WP on Fair payment for infrastructure use	
- Charging									
- TEN					Decision on TEN guidelines	COM: Connecting EU transport infrastr. to its neighbours			Report on revision of TEN guidelines
General transport policy		WP: future development of Common Transport Policy						COM: Common Transport Policy Sustainable Mobility: Perspectives	COM: Cohesion and transport
<b>Statistics</b> (Legal acts)	Modifica-tion of Road Directive		Council Dec. on CARE	Maritime Directive 95/64		Road Directive 1172/98		Preparation of revision of rail directive	
<b>Research</b>	EURET (FP 2)	EURET (FP 2)	APAS FP 4: 1st call	FP 4: 2nd call 12/95	FP 4: 3rd call 12/96	FP 4: 4th call 12/97	FP 4	FP 4 FP 5: preparat.	FP 5: 1st call

Source: European Commission.

## **2. EU transport policy and benchmarking**

After the creation of a single market (1993) and the liberalisation of transport,<sup>1</sup> European transport policy focus has shifted to the implications of the transport demand of a single European economic space (trans-European networks) and of a liberalised transport market (internalisation of external costs, policies to promote rail, inland water, short sea and combined transport) and to the impact of transport demand (accidents, environmental impact). An integrated view of transport has also emerged (examples: TEN, promotion of intermodal transport).

In the past, legislative tools were in the foreground (they were necessary for market liberalisation and creation of environmental standards). To achieve the goals of the Common Transport Policy and make transport sustainable and more efficient, use of non-legislative tools is also necessary. Non-legislative tools are especially important for new policy fields like the promotion of intermodality.

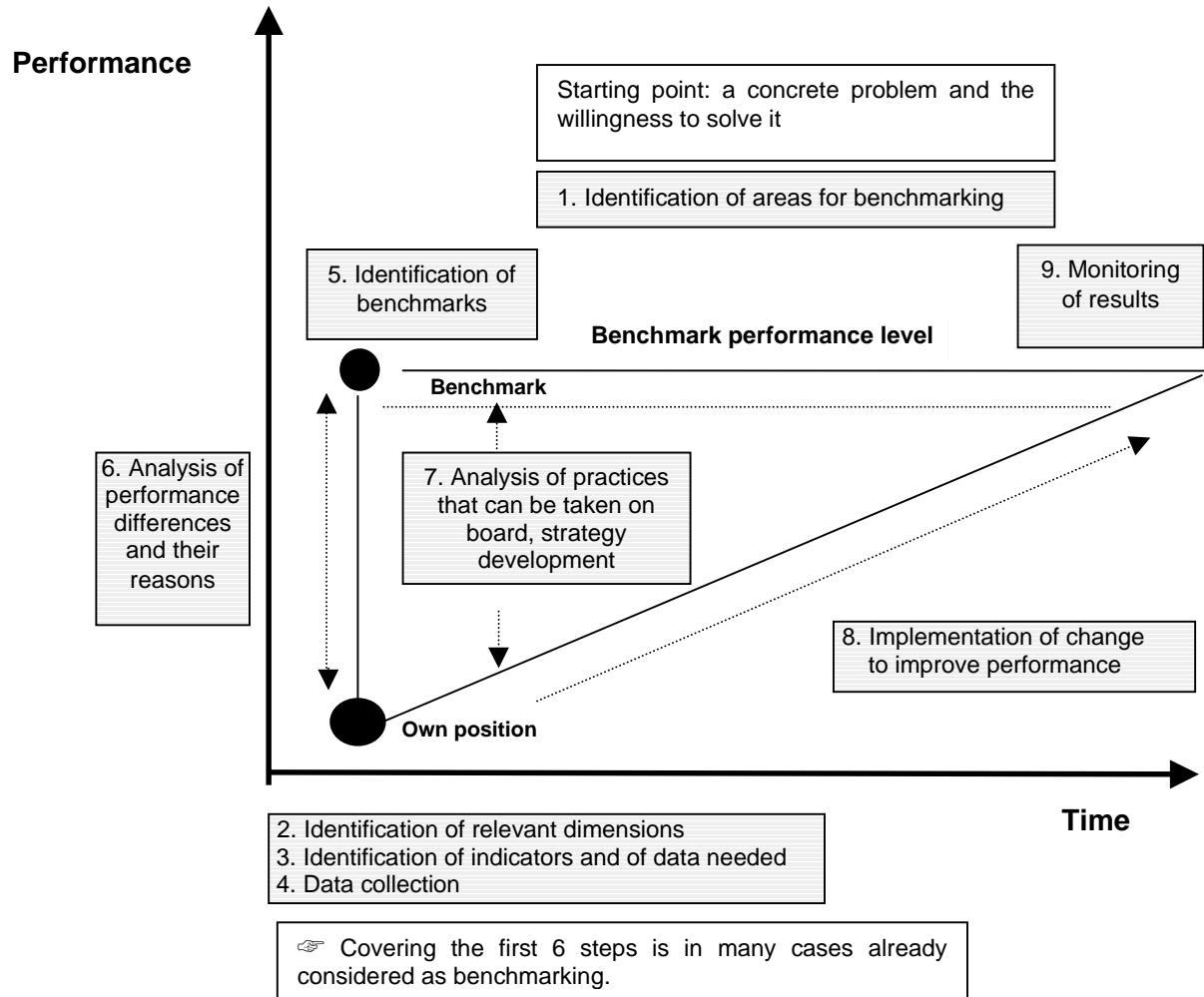
Benchmarking is emerging as an important non-legislative tool in European transport policy.

European transport benchmarking projects have already been carried out for urban transport.

The aim is to further promote the use of this tool on all levels of the transport market in order to achieve the goals of the Common Transport Policy.

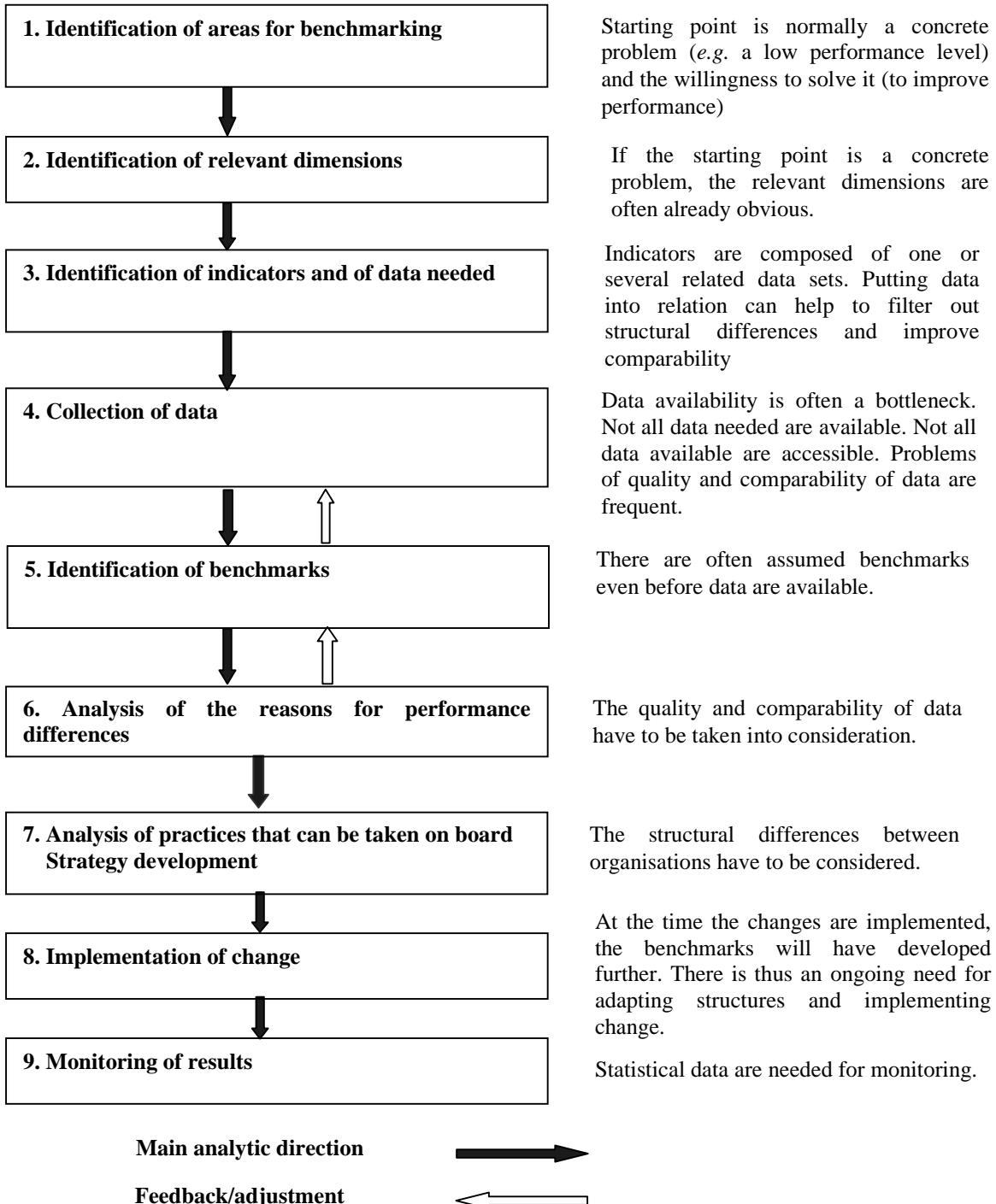
1. The liberalisation of the transport market was not fully achieved in 1993 but liberalisation was almost completed in 1999. Air cabotage was liberalised in 1997, road transport cabotage in 1998, and the inland navigation *tour de rôle* system was abolished 1999.

### 3. Benchmarking: basic steps



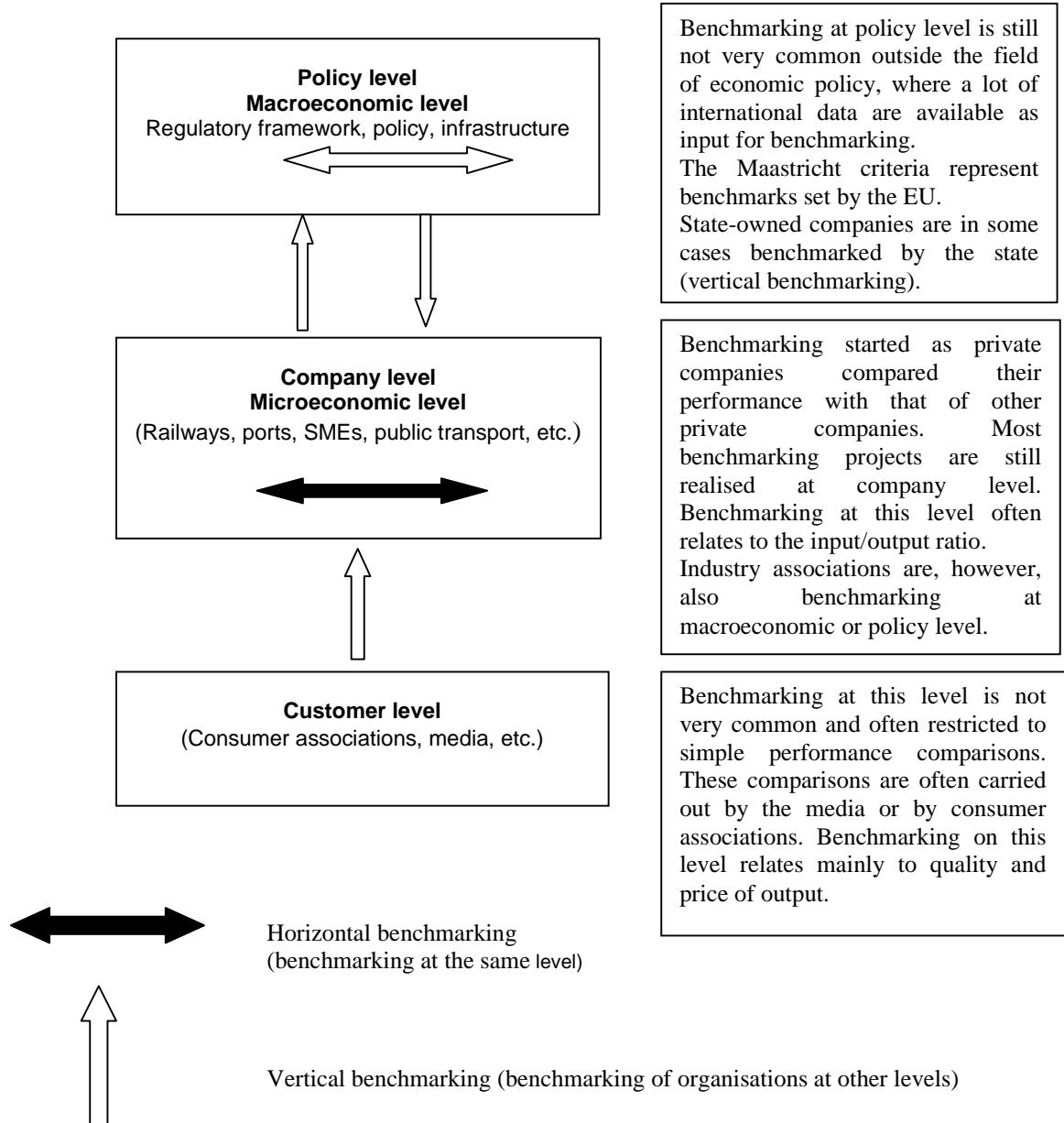
Source: European Commission.

### 3. Benchmarking: basic steps (*continued*)



Source: European Commission.

#### 4. Overview of transport benchmarking levels

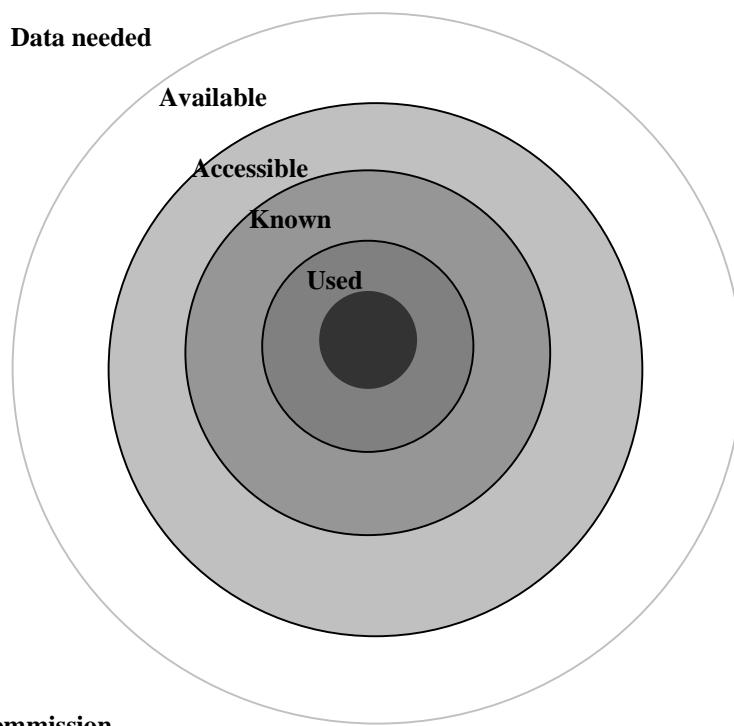


Source: European Commission.

## 5. Problems with data

### Availability and use of data

<b>Availability</b>	Not all data needed are available. Statistical data are a bottleneck for many benchmarking projects
<b>Accessibility</b>	Not all data available are accessible. Private companies consider certain data as confidential and do not disclose them.
<b>Awareness</b>	Not all data accessible are known. Information on data available/accessible is often missing.
<b>Use</b>	Not all data known are used. Many data that could be used for benchmarking are under exploited.
<b>Interpretation</b>	Not all data used are used or interpreted correctly (often problems of precision and comparability are not considered).



*Source:* European Commission.

### Data quality requirements

Data quality aspect	Comment
<b>Precision</b>	Precision of data is especially important if differences between results are small or if trends over time are analysed (data should at least be precise enough to mirror trends correctly).
<b>Comparability</b>	Comparability of data is very important for benchmarking. Data sets are often defined differently, especially as regards transport data at Member State or city level (example: urban modal split data).
<b>Comprehensiveness</b>	For benchmarking purposes, data do not have to cover all countries or units assessed but should include the best performance/benchmark. The more aspects of performance covered the better.
<b>Timeliness</b>	Data should be as current as possible in order to reflect latest trends.

## 6. Use of absolute and relative figures

### Example: railway passenger transport

	Absolute figures	Two figures put in relation	Three figures put in relation
	Passenger-km, 1997	Modal share of rail transport, 1995	Change of modal share, 1990-95
	Billions	%	
Germany	<b>64.0</b>	<b>7.2</b>	-0.1
France	<b>61.8</b>	7.0	-1.9
Italy	<b>52.1</b>	6.5	-0.4
United Kingdom	34.4	4.3	-0.5
Spain	17.3	4.0	-0.8
Netherlands	14.4	<b>7.8</b>	<b>+1.1</b>
Austria	8.3	<b>10.7</b>	+0.1
Belgium	7.0	6.0	-0.5
Sweden	6.3	6.0	<b>+0.4</b>
Denmark	5.2	6.4	-0.9
Portugal	4.6	3.9	-2.7
Finland	3.4	5.1	-0.1
Greece	1.9	1.8	-0.9
Ireland	1.4	2.6	-0.3
Luxembourg	0.3	5.3	<b>+0.8</b>
United States	22	0.3	
Japan	370	28	

Bold = leading EU countries.

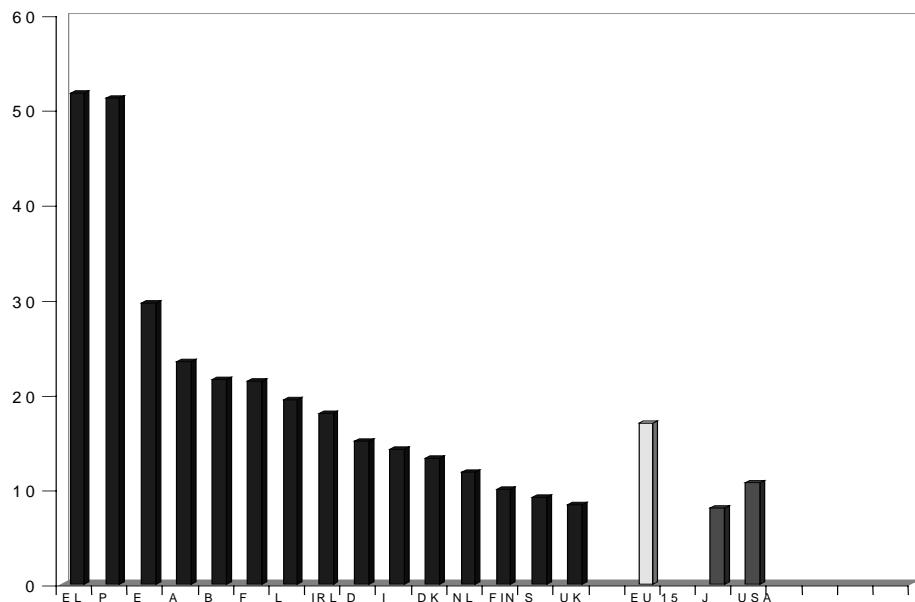
The more figures put in relation to each other the better structural differences are filtered out. At the same time, figures become more abstract and in some cases more difficult to understand. Problems with data availability increase.

Source: European Commission.

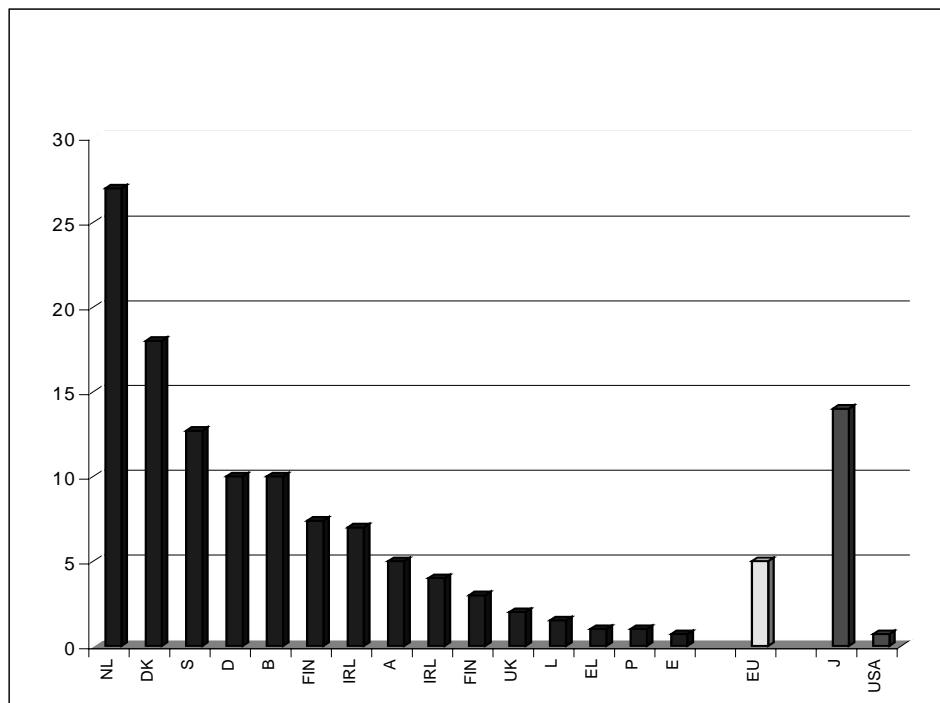
<b>Absolute figures</b>	At country level, absolute figures normally cannot be used for benchmarking because they do not filter out differences in the size of countries.
<b>Two figures put in relation</b>	<p>Relative figures, which relate two figures (like modal split) are better suited for benchmarking.</p> <p>They are easy to understand.</p> <p>However, these figures do not filter out structural differences between countries. They therefore have to be interpreted with care. Qualitative information is needed to complement such data.</p>
<b>Three figures put in relation</b>	If three figures are put into relation (example: change of modal split over time) most structural differences can normally be filtered out. However, the results still have to be interpreted with care (example: it is more difficult to increase the modal share of a certain mode if the modal share is very high or very low, compared to a medium share of this mode).

## 7. Examples of statistical results at country level

Example 1. Transport safety  
Fatalities per billion vehicle-km, 1996

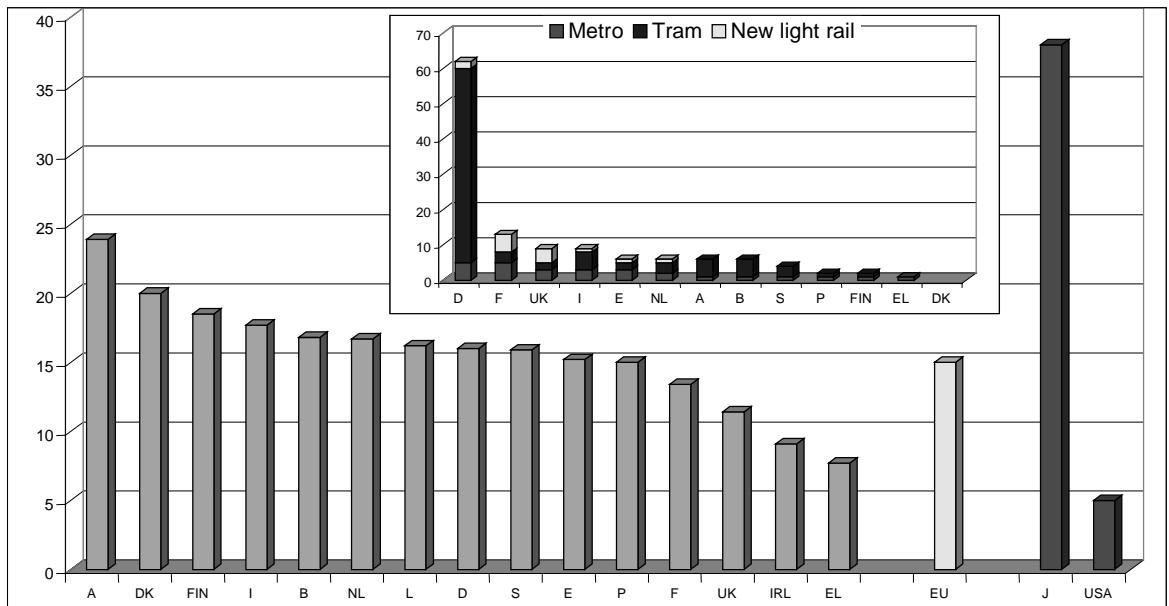


Example 2. Cycling  
Modal share (% of all trips)

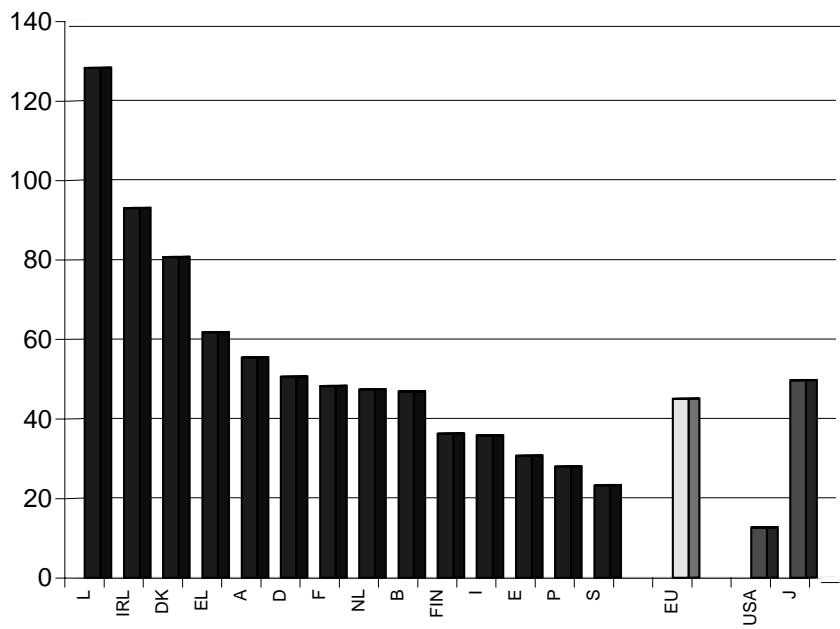


Source: European Commission.

**Example 3. Public transport**  
**Market share (% of land transport p-km) and urban rail systems (1999)**

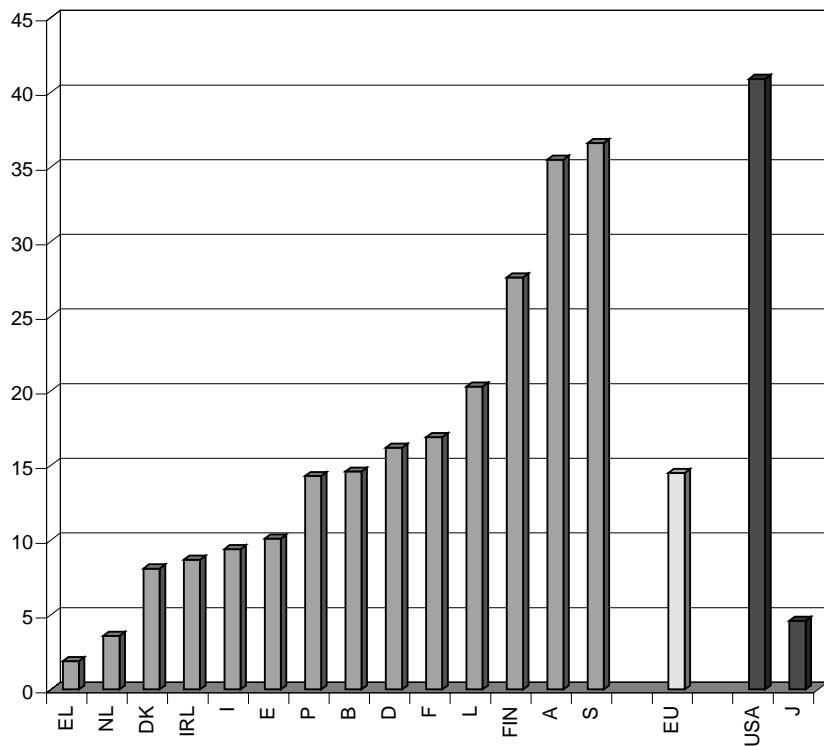


**Example 4. Rail freight tariffs, 1996**  
**Receipts (ECU/1 000 t-km)**

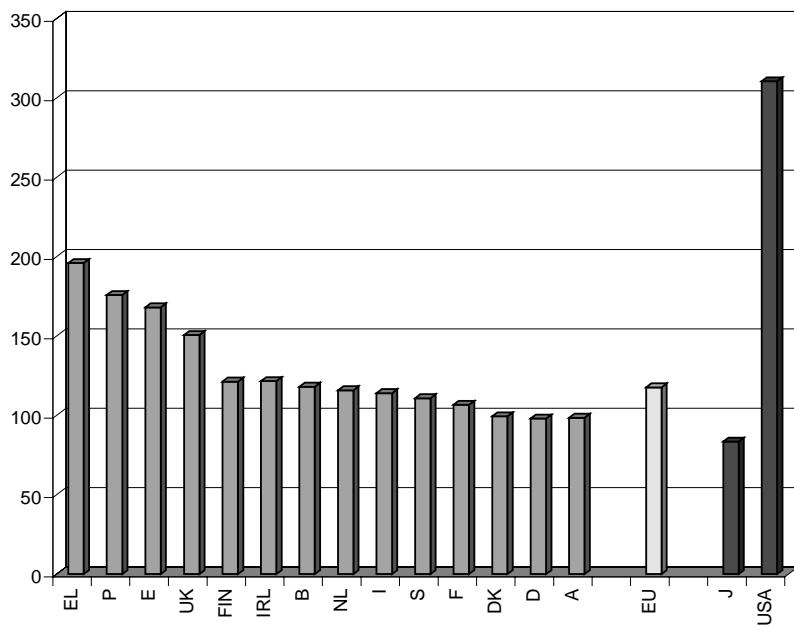


Source: European Commission.

**Example 5. Rail freight transport, 1997**  
**Market share (% of t-km)**



**Example 6. Transport intensity of the economy and CO<sub>2</sub> emissions**  
Kg CO<sub>2</sub> per ECU 1 000 value created



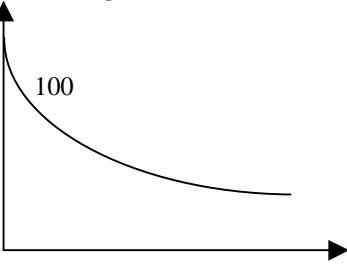
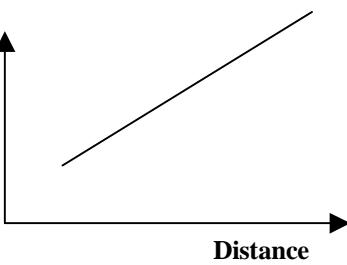
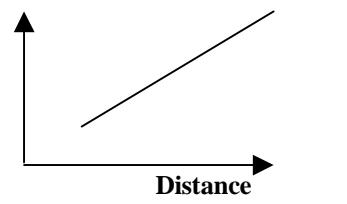
Source: European Commission.

## **8. Problems relating to transport benchmarking at aggregate (country) level**

1. Transport is a very complex field with many interrelationships between structural factors, transport supply and demand.
2. Transport is partially determined by structural factors (different factors at the same time), which are beyond the influence of transport policy.
3. Transport policy is only one of several factors that influence the development of transport.
4. Data availability, quality and comparability limit the possibilities for transport benchmarking.
5. The impact of transport policy on transport demand is often not very strong.
6. The margin of error in statistical results relating to transport demand (which for many modes is a result of modelling) is often bigger than the impact of specific policies on demand.
7. Nevertheless benchmarking and the analysis of performance differences can provide useful insights that help to improve the effectiveness of policy. Quantitative comparisons should be accompanied by qualitative information.

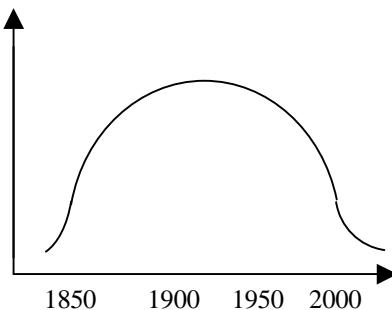
## 9. Modal split as an example for the complexity behind simple statistical results:

### General rules Modal split – general factors

Graph	Rule
<b>Share of a given mode</b>  <p><b>Number of modes considered</b></p>	<p>Introductory remarks: <b>Impact of different calculation methods</b></p> <p>There are many ways to calculate a modal split. Modal shares depend on calculation methods and definitions. An important factor is the number of modes considered: the more modes included in the total the smaller the market share of each mode. Often only inland transport modes are considered (sea and air transport missing). In passenger transport, modal split figures often refer only to motorised transport.</p> <p>Another key factor is the reference basis for calculations. Calculations based on volume (trips or tonnes) favour short-distance modes, those based on performance (passenger-km or tonne-km) favour long-distance modes.</p> <p>A third important factor is geographic reference: modal shares should preferably be calculated on the basis of traffic on a territory. Often they only relate to national transport of enterprises of a given country. In some cases international transport is included.</p> <p>Modal split data for urban areas often only include trips within the urban area. Outgoing, incoming and transit trips are normally not considered (short-distance modes are overstated).</p>
<b>Size of transport vessel</b>  <p><b>Distance</b></p>	<p><b>Transport distance and modal shares in freight transport</b></p> <p>The longer the distance the larger the transport vessel used because specific transport costs decline with the amount of goods transported. Long-distance flows are also more concentrated (in part because feeder modes are used) than diffuse short-distance movements, which require frequent transport and small vessels.</p> <p>Example: Vans and small lorries are used for short-distance freight transport, heavy trucks with trailers and railway trains for medium and long distances. Large ocean ships are used for intercontinental transports.</p> <p>☞ As a result of the growing value density of products, transport time is becoming more important and freight transport by air is growing quickly.</p>
<b>Speed of transport vessel used</b>  <p><b>Distance</b></p>	<p><b>Transport distance and modal shares in passenger transport</b></p> <p>The longer the distance, the faster the transport vessel used.</p> <p>Transport distances are growing and fast modes are growing more quickly than slow ones. Travel time is one of the most important decision factors in passenger transport (its importance is also growing in freight transport). Travel time including access and egress is taken into account when selecting a mode. Transport costs also play a role, and fast modes are normally more expensive than slow ones.</p>

## Market share

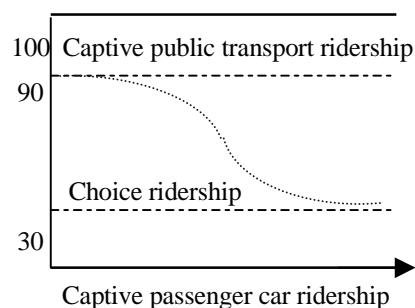
Example: rail pass traffic: Germany



## Life cycle (modal split development over time)

The assumed life cycle used in market research to analyse the development of product market shares can also be applied to transport systems and individual means of transport since, to a certain extent, these can also be seen as products on the (transport) market. Least affected by life-cycle development are modes of transport with their own niche, such as air transport and maritime shipping. Most affected are modes that compete directly, such as road and rail. Rail, which is particularly affected by the competitive substitution of roads, is a textbook case for life-cycle development (development, expansion, zenith/dominance, contraction). Rail transport systems are being relaunched (starting of a new life cycle) via the development of new products (high-speed trains, new urban rapid transit systems). Bicycles also are undergoing life cycle development (rising cycle traffic in Northern Europe since the oil crises, relaunch owing to innovation (e.g. mountain bike)). The development and expansion of the motor car and its traffic share followed the first phases of life cycle development. However, it seems that the car is an "evergreen": its importance will not contract much in future.

## Traffic share



Journey time relation public/private transport

## Modal split model

When private-car traffic and public transport use are examined, a distinction must be drawn between choice riders and captive drivers or riders.

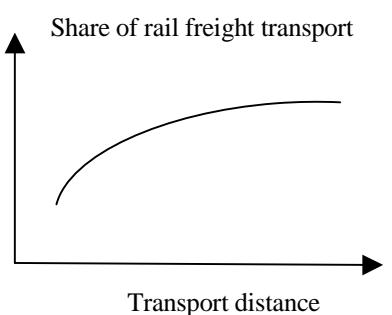
Captive travellers are unable to choose between transport modes (e.g. they have no car or they must use the car to transport objects). They represent the lowest level of usership of a given means of transport. Choice riders instead are able to choose between modes. They select a means of transport according to criteria such as relative journey time and costs. Example: As shown in the graph, journey time relation is often used for modal split models, as journey time is a key decision factor for modal choice.

☞ In general, a logistical curve applies here: given amounts of journey time improvements have less impact on modal split when the relationship is very favourable for public transport or private transport than in a more balanced situation.

## Modal split – General rules

### Specific factors: freight transport

#### Graph



#### Rule/empirical observation

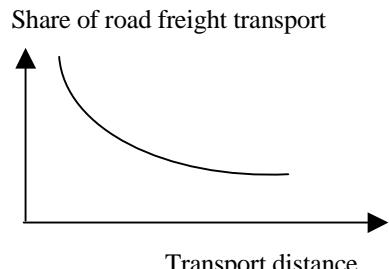
##### Rail freight transport

The modal share of rail freight transport increases with transport distance.

The competitiveness and productivity of rail improves with transport distance and with the amount of goods transported, owing to the relatively high share of fixed costs (including the friction costs of loading/unloading) and the low share of variable costs of rail transport. Short-distance transport is often characterised by diffuse, frequent transports of small consignments, a market for a low capacity mode like road transport. Traffic flows in long-distance transport are also more concentrated, a more adequate market for a medium-/high-capacity mode like rail transport.

The modal share of freight transport also depends on:

- Production structure (the importance of the mining sector and the steel industry).
- Availability of competing modes (e.g. inland navigation).
- Liberalisation of the transport market and competition within the sector.

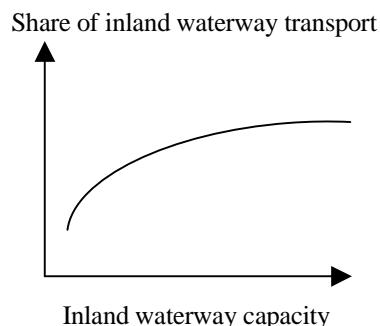


### Road freight transport

The modal share of road transport declines with transport distance. Compared to rail, road has a relatively high share of variable costs and a low share of fixed costs. The competitiveness of road compared to rail declines with transport distance and amount of goods transported. With a network of 4 million km (compared to 166 000 km for rail and 30 000 km for inland waterways), road is for many transport relations the only mode that can provide door-to-door transport. For short-distance transport, there is often no alternative to road transport (captive market).

The modal share of road freight transport also depends on:

- Production structure (share of agricultural products and manufactured goods).
- Availability of competing modes (rail and inland navigation).



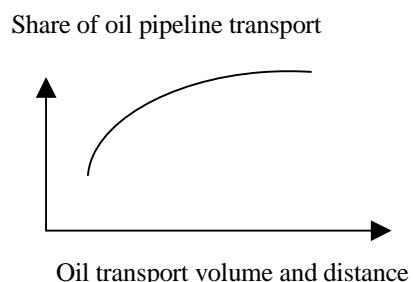
### Inland navigation

The modal share of inland navigation depends on the availability of inland waterways of a certain carrying capacity class and their location in relation to main traffic flows.

The geographic location of ports and of manufacturing production sites in the hinterland (especially iron/steel and chemical industry) and their connection by high-capacity inland waterways is thus important.

The modal share of inland navigation also depends on:

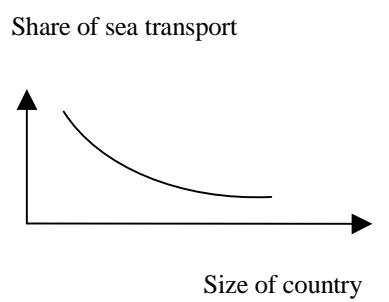
- The production structure. Bulk goods like coal, petroleum, chemical products and building materials are markets for inland navigation.
- The climate. The share is in general lower in dry climates (unstable water supply) and in cold climates (ice-covered waterways in winter, especially a problem in Scandinavia and Eastern Europe) than in temperate climates.



### Oil pipeline transport

The modal share of oil pipeline transport depends on the amount and distance of oil products transported (and the spatial concentration of the oil transport flows). It also depends on the availability of oil import ports and the distance between these ports and the hinterland.

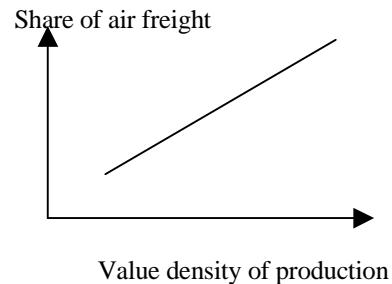
☞ Oil exports are more likely to be transported by pipeline than imports because export flows to the ports are more concentrated than import flows from the ports.



### Sea transport

The modal share of sea transport declines with the size of a country and increases with the length of the coastline

The larger a country the larger the share of inland transport flows (transported by inland modes) and the lower the share of international flows (often transported by sea). The topography (coastline) of a country obviously also plays a role.



### Air freight transport

The modal share of air freight transport increases with the value density of production. The modal share of air transport increases with the development of an economy.

Other important factors are:

- Export orientation of an economy.
- Geographic situation (isolation, availability of land links to trade partners).

Even in highly developed economies, the modal share of air transport, measured by weight, remains small compared to other modes.

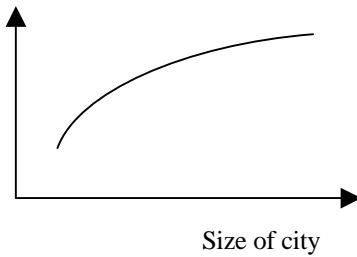
☞ However, by value, air transport already represents one-quarter of EU exports (1% by weight).

## Modal split – General rules Specific factors: passenger transport

Graph	Rule/empirical observation
<p>A graph with 'Share of walking' on the vertical axis and 'Per capita income' on the horizontal axis. A curve starts high on the left and slopes downwards and to the right, indicating a negative correlation.</p>	<p><b>Walking</b></p> <p>The share of walking declines with per capita income. Journey lengths and mobility per person rise with per capita income, and walking tends to be replaced by mechanised forms of transport. Other factors are:</p> <ul style="list-style-type: none"> <li>- Population density in settlements and average distances.</li> <li>- Availability of other modes.</li> <li>- Conditions for pedestrians and for other modes (pedestrian areas, traffic calming).</li> </ul> <p>☞ While the modal share of walking continues to decline, the number of km walked per person in Europe has been stable in the last decades at around 1 km per person and day.</p>
<p>A graph with 'Share of cycling' on the vertical axis and 'Size of town' on the horizontal axis. A curve starts low, rises to a peak, and then falls again, indicating a non-linear relationship where cycling is most prevalent in medium-sized cities.</p>	<p><b>Cycling</b></p> <p>The share of cycling is highest in medium-sized cities. In rural areas, transport distances are either very short (within villages) or too long for cycling; conditions for private car traffic are good, parking spaces are normally available. In large cities transport distances are long and public transport services are of good quality. Medium-sized cities often have the highest share of cycling. Public transport services are limited compared to large cities and private car traffic faces a lack of parking spaces. Modal shares of cycling are especially high in university cities with a large student population (these cities often have a cycling tradition and cycle-friendly policies). Other important factors are:</p> <ul style="list-style-type: none"> <li>- Topography (the flatness of an area).</li> <li>- Population share of pupils and university students.</li> <li>- Status differences in society and attitudes towards and perception of the bicycle.</li> <li>- Availability of cycling infrastructure.</li> </ul>

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Share of public transport



### Public transport

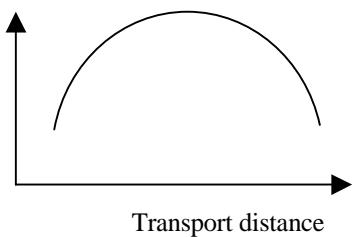
The share of public transport increases with city size.

Conditions for private car transport deteriorate with the size and density of a city (traffic jams, lack of parking space) while those for public transport improve.

For public transport, there is a positive relation between demand and supply. Public transport improves with growing demand: supply grows, more trains and buses are run, separate infrastructure is constructed (underground, light rail lines) and use of public transport is socially more accepted.

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Rail passenger transport share



### Railway transport

The share of railway passenger transport depends on transport distances, spatial distribution of the population and availability of rail infrastructure.

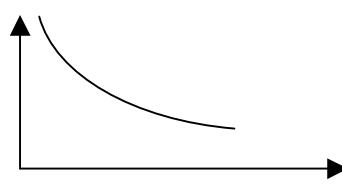
The railway is a passenger transport mode for medium distances. If transport distances are too short people will use local public transport or the car; if transport distances are very large they will use air transport.

The density of the rail infrastructure and the quality of the transport services (service density, availability of high-speed traffic) are other important factors.

The share of rail traffic is relatively high in mountainous countries where the topography leads to a concentration of population and a bundling of traffic flows (Switzerland, Japan).

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Share of car transport



### Car transport

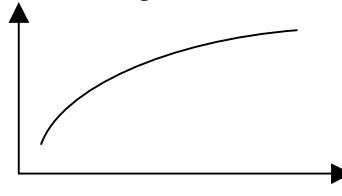
The share of car transport declines with the size and population density of urban areas.

The larger the city the smaller the share of private car transport. The share of private car transport is also related to the quality of public transport (which tends to increase with city size and density).

Over time, the share of car traffic grows up to a certain point, but it later falls as the share of air traffic increases with per capita income more quickly than car traffic.

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Share of air transport



### Air transport

The share of air transport increases with per capita income.

As per capita income increases, people spend a growing part of their income on personal travel. They also tend to travel to more distant destinations.

Economic growth is linked to an economy's international integration, and this implies growth in business trips by air.

In general, as income increases people tend to buy speed and to replace slow modes by fast ones.

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## Analysis of determinants of modal split : Conclusions

Structural differences between countries have a strong impact on modal split. Most of the structural differences are beyond the influence of (transport) policy.

Country size	<p>Transport distances in freight transport tend to grow with the country's size. Share of road transport tends to decline with transport distance while share of other modes increases.</p> <p>With globalisation and European economic integration, the impact of a country's geographic size tends to decline. However, this does not always become obvious in the statistics, which often cover transport performance of inland modes only.</p> <p>A country's size has a much smaller impact on passenger transport (mobility dominated by daily short-distance trips like commuting, shopping, etc.).</p>
Development level/ country's per capita income	<p>With rising income, non-motorised transport tends to be replaced by motorised transport, average trip lengths grow and long-distance trips become more important.</p> <p>Motorisation increases with per capita income levels. Availability of a passenger car has a strong impact on mobility patterns and on modal split. Number of air trips per person is also strongly related to per capita income or GDP levels.</p> <p>Average income has a stronger impact on passenger transport than on freight transport.</p>
Topographic situation	<p>Waterborne transport obviously depends on availability of waterways (of a certain carrying capacity).</p> <p>A topography that bundles transport flows along valleys and corridors (<i>e.g.</i> mountainous areas) generally provide good conditions for a high modal share of rail transport (although rail transport has difficulties with gradients).</p>
Production structure	<p>Because of their carrying capacity, rail and water transport are better placed for transporting bulk cargo (raw materials, steel, chemicals) than road transport. Road transport better fits the transport needs of light industry. The production structure (and shares of bulk and of general cargo) therefore has a strong impact on modal shares in freight transport.</p>
Climate	<p>Mild and wet climates provide better conditions for inland waterway transport than dry (insufficient and unstable water supply) or very cold climates (waterway traffic hampered by ice). Cold climates favour rail against road transport (rail is less affected than road by snow and ice).</p>
Socio-demographic factors	<p>The population's age structure affects the modal split in passenger transport (pupils, and to a certain extent the elderly, are captive markets for public transport). Social stratification also plays a role. Middle-class societies tend to have a higher share of public transport than societies with strong disparities between social classes (which are often accompanied by a spiralling down of the quality of public transport).</p>
Cultural factors	<p>Cultural factors play an important role in mobility behaviour and thus in passenger transport. An example is cycling, which is not accepted and perceived in all societies as a normal transport mode for adults (acceptance is higher in northern than in southern countries).</p>

Source: European Commission.

## 10. Benchmarking the performance of countries (competitiveness) Reports and data available on the Internet

Report	Issued by (organisation) Description of content, Internet address	Results (top rankings)																				
World Competitiveness Report	<p>Institute for Management Development IMD, Lausanne Annual, latest issue: 1999 Internet: <a href="http://www.imd.ch/wcy">www.imd.ch/wcy</a> (rankings, summary) Countries: 47 Criteria: domestic economy, internationalisation, government, finance, infrastructure, management, science &amp; technology, people General: This is the most often quoted competitiveness report</p>	<p>Top 10 World 1999 (competitiveness)</p> <table style="margin-left: 20px;"> <tr><td>1 United States</td><td>100</td></tr> <tr><td>2 Singapore</td><td>86</td></tr> <tr><td>3 Finland</td><td>83</td></tr> <tr><td>4 Luxembourg</td><td>81</td></tr> <tr><td>5 Netherlands</td><td>81</td></tr> <tr><td>6 Switzerland</td><td>80</td></tr> <tr><td>7 Hong Kong</td><td>80</td></tr> <tr><td>8 Denmark</td><td>78</td></tr> <tr><td>9 Germany</td><td>77</td></tr> <tr><td>10 Canada</td><td>76</td></tr> </table>	1 United States	100	2 Singapore	86	3 Finland	83	4 Luxembourg	81	5 Netherlands	81	6 Switzerland	80	7 Hong Kong	80	8 Denmark	78	9 Germany	77	10 Canada	76
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10 Canada	76																					
Global Competitiveness Report	<p>World Economic Forum, Cologny (Geneva) Annual, latest issue: 1999 Internet: <a href="http://www.weforum.org/publications/GCR">www.weforum.org/publications/GCR</a> (rankings, summary) Countries: 59 Criteria: openness, government, finance, infrastructure, technology, management, labour, institutions, General: qualitative data from corporate executive survey included WEF also issues "Africa Competitiveness Report"</p>	<p>Top 10 World 1999 (competitiveness)</p> <table style="margin-left: 20px;"> <tr><td>1 Singapore</td><td>2.12</td></tr> <tr><td>2 United States</td><td>1.58</td></tr> <tr><td>3 Hong Kong</td><td>1.41</td></tr> <tr><td>4 Taiwan</td><td>1.38</td></tr> <tr><td>5 Canada</td><td>1.33</td></tr> <tr><td>6 Switzerland</td><td>1.27</td></tr> <tr><td>7 Luxembourg</td><td>1.25</td></tr> <tr><td>8 United Kingdom</td><td>1.17</td></tr> <tr><td>9 Netherlands</td><td>1.13</td></tr> <tr><td>10 Ireland</td><td>1.15</td></tr> </table>	1 Singapore	2.12	2 United States	1.58	3 Hong Kong	1.41	4 Taiwan	1.38	5 Canada	1.33	6 Switzerland	1.27	7 Luxembourg	1.25	8 United Kingdom	1.17	9 Netherlands	1.13	10 Ireland	1.15
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Index of Economic Freedom	<p>Heritage Foundation, Washington Annual, latest issue: 1999 Internet: <a href="http://www.heritage.org/heritage/index">www.heritage.org/heritage/index</a> (rankings, summary) Countries: 154 Criteria: trade, taxation, government intervention, monetary policy, foreign invest., banking, wages and prices, property rights, regulation, black market (all criteria have the same weight, scores: 1-5) General: conservative view of economic freedom, countries are classified as free, mostly free, mostly unfree or repressed</p>	<p>TOP 10 World 1999 (economic freedom)</p> <table style="margin-left: 20px;"> <tr><td>1 Hong Kong</td><td>1.25</td></tr> <tr><td>2 Singapore</td><td>1.30</td></tr> <tr><td>3 Bahrain</td><td>1.70</td></tr> <tr><td>4 New Zealand</td><td>1.75</td></tr> <tr><td>5 Switzerland</td><td>1.85</td></tr> <tr><td>6 United States</td><td>1.90</td></tr> <tr><td>7 Ireland</td><td>1.95</td></tr> <tr><td>8 Luxembourg</td><td>1.95</td></tr> <tr><td>9 Taiwan</td><td>1.95</td></tr> <tr><td>10 United Kingdom</td><td>1.95</td></tr> </table>	1 Hong Kong	1.25	2 Singapore	1.30	3 Bahrain	1.70	4 New Zealand	1.75	5 Switzerland	1.85	6 United States	1.90	7 Ireland	1.95	8 Luxembourg	1.95	9 Taiwan	1.95	10 United Kingdom	1.95
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Report	Issued by (organisation) Description of content, Internet address	Results (top rankings)																							
World Bank Competitiveness Indicators	World Bank, Washington Electronic database, no information on periodicity/updating Internet: <a href="http://wbln0018.worldbank.org/psd/compete.nsf">wbln0018.worldbank.org/psd/compete.nsf</a> (database) Countries: > 100, depends on indicator Criteria: 49 indicators for overall performance, macro and market dynamism, financial dynamism, infrastructure and investment climate, human resources Transport indicators: paved-road density (paved roads per million population), air city pairs (number of foreign cities to which the main airport is connected via scheduled flights).	Top 10 World (transport indicators) <table> <tr><td>Paved road density</td><td>Air city pairs</td></tr> <tr><td>1 Austria</td><td>1 United Kingdom</td></tr> <tr><td>2 Ireland</td><td>2 Germany</td></tr> <tr><td>3 Australia</td><td>3 France</td></tr> <tr><td>4 Norway</td><td>4 USA</td></tr> <tr><td>5 New Zealand</td><td>5 Netherlands</td></tr> <tr><td>6 Lithuania</td><td>6 Belgium</td></tr> <tr><td>7 United States</td><td>7 Hong Kong</td></tr> <tr><td>8 Denmark</td><td>8 Japan</td></tr> <tr><td>9 Canada</td><td>9 Singapore</td></tr> <tr><td>10 Sweden</td><td>10 Denmark</td></tr> </table>		Paved road density	Air city pairs	1 Austria	1 United Kingdom	2 Ireland	2 Germany	3 Australia	3 France	4 Norway	4 USA	5 New Zealand	5 Netherlands	6 Lithuania	6 Belgium	7 United States	7 Hong Kong	8 Denmark	8 Japan	9 Canada	9 Singapore	10 Sweden	10 Denmark
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Human Development Index	United Nations Development Programme, New York Annual, Latest issue 1999 Internet: <a href="http://www.undp.org/undp/hdro">www.undp.org/undp/hdro</a> (rankings) Countries: 175 Criteria: life expectancy, adult literacy, gross enrolment ratio, real GDP per capita (in purchasing power parities)	Top 10 World (human development) <table> <tr><td>1 Canada</td><td>6 Sweden</td></tr> <tr><td>2 Norway</td><td>7 Australia</td></tr> <tr><td>3 United States</td><td>8 Netherlands</td></tr> <tr><td>4 Japan</td><td>9 Iceland</td></tr> <tr><td>5 Belgium</td><td>10 United Kingdom</td></tr> </table>		1 Canada	6 Sweden	2 Norway	7 Australia	3 United States	8 Netherlands	4 Japan	9 Iceland	5 Belgium	10 United Kingdom												
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Corruption Perception Index	Transparency International (Berlin) <a href="http://www.gwdg.de/~uwvw/">www.gwdg.de/~uwvw/</a> Assessment of perceived corruption in 55 countries	1. Denmark 2. Finland 3. New Zealand																							
TIMSS	Third International Mathematics and Science Study International Association for the Evaluation of Educational Achievement IEA (Boston, USA) <a href="http://wwwcsteep.bc.edu/timss">wwwcsteep.bc.edu/timss</a>	Mathematics, third grade <table> <tr><td>1. Netherlands</td></tr> <tr><td>2. Sweden</td></tr> <tr><td>3. Iceland</td></tr> </table>		1. Netherlands	2. Sweden	3. Iceland																			
1. Netherlands																									
2. Sweden																									
3. Iceland																									

Source: European Commission.

### **Example: IMD World Competitiveness List 1999**



*Source : IMD.*

## Websites

<a href="http://www.europa.eu.int/en/comm/dg07/tif">http://www.europa.eu.int/en/comm/dg07/tif</a>	<b>Data on European transport</b>
<a href="http://www.eltis.org/benchmarking">http://www.eltis.org/benchmarking</a>	<b>Urban transport benchmarking project</b>
<a href="http://www.benchmarking-in-europe.com">http://www.benchmarking-in-europe.com</a>	<b>Benchmarking site initiated by DG Enterprise</b>
<a href="http://www.benchmarking.org">http://www.benchmarking.org</a>	<b>Benchmarking and best practices network</b>



## **5. QUALITY OF EUROPEAN TRANSPORT STATISTICS REQUIREMENTS, RESULTS AND PROSPECTS**

*by*

**Stefan Rommerskirchen  
Head of Transport Department, Prognos AG, Switzerland**

### **Introduction**

Demand for transport in Europe has increased sharply over the 1990s. Important reasons are the “completion of the internal market” in the EU and the opening up of Central and Eastern Europe following the fall of the Iron Curtain. This development has been further encouraged in most European countries by a real increase in purchasing power, falling transport costs, increased leisure time and continuing improvements in logistical services provided to an economy increasingly based on the international division of labour.

These developments, which are desirable in principle, leading as they do to increased mobility of people and goods, nevertheless have undesirable side effects, such as the emission of exhaust gases, harmful substances and noise, the consumption of limited resources (such as fossil fuels or land), and traffic accidents. That is why – despite a fundamental trend towards deregulation in most European countries – governments have shown an increased willingness to intervene in the demand for transport by appropriate transport policies.

Transport statistics constitute an important basis for diagnosing and treating transport problems. The information available is not, however, commensurate with the problems to be addressed. For this reason, the Directorate-General Transport of the EU Commission engaged Prognos AG at the end of 1998 to investigate “Short-term Trends in the European Transport Market”, which involved, among other things, gathering the available statistical information on the development of demand for transport and processing it, through revisions and estimates, so as to provide a coherent and up-to-date picture of developments in the European passenger and goods transport market.

The problems outlined below concerning the quality of statistical data on transport derive chiefly from experience gained during this study, although Prognos has been compiling statistical information on European transport for many years and has devised concepts for the further development of transport statistics for the Statistical Office of the European Communities (Eurostat) and for national clients (in Germany and Switzerland).

## **Transport statistics fields**

At the beginning of the 1990s, as part of its work to provide a methodological basis for transport statistics, Eurostat, assisted by Prognos, developed a data system with the following nine fields:

- Transport infrastructure.
- Vehicles and means of transport.
- Information about enterprises.
- Vehicle movements and mileage.
- Traffic volume and performance.
- Energy consumption and environmental impact of traffic.
- Traffic safety.
- Prices and user fees.
- Other (transport-relevant information, such as statistics on driving licences or results of enquiries on attitudes towards traffic issues).

This catalogue should reasonably cover those areas which the different groups using transport statistics – transport policy makers and their advisers, the administration, the economy, the academic world, the media and other interested parties – might need. But this “basic structure”, however plausible it might appear, cannot yet be found in transport statistics; only a few transport statistical publications cover this data programme with any degree of completeness.

## **Institutions and publications on transport statistics**

Three public institutions in Europe deal with the collection and publication of comprehensive transport statistics on a supranational scale:

- The Statistical Office of the European Communities (Eurostat, Luxembourg).
- The European Conference of Ministers of Transport (ECMT, Paris).
- The United Nations Economic Commission for Europe (UN ECE, Geneva).

The most important publications of these institutions, covering several transport fields and/or modes, are, to the best of our knowledge, the following (editions quoted are the latest as of 29 October 1999):

Eurostat:

- *Transport: Annual Statistics 1970-1990* (Luxembourg, 1992)
- *EU Transport in Figures*, Statistical Pocket Book (most recent Internet version: October 1999; the latest edition reflects the position in April 1999); this publication is a product of the DG Transport, published in co-operation with Eurostat.

ECMT:

- Statistical Trends in Transport (1965-1994, Paris 1998).
- Trends in the Transport Sector (1970-1997, Paris 1999).

UN ECE:

- *Annual Bulletin of Transport Statistics for Europe and North America* (1998, Geneva 1999).

All countries have national statistical offices, which produce and publish, partly in co-operation with the Ministries of Transport or other public bodies, transport statistics which differ considerably in scope and timeliness. References to such offices, ways of accessing them and Web pages are to be found *inter alia* in *EU Transport in Figures*. Examples of publications that offer a good overview of transport statistics compiled by national statistical offices include: *Key Figures for Transport* (Statistics Denmark and Danish Ministry of Transport, Copenhagen); *Mémento des Statistiques des Transports* (Ministère de l'Équipement, des Transports et du Logement, Paris); *Transport and Communication Statistical Yearbook for Finland* (Statistics Finland, Helsinki); *Yearbook of Transport and Communications* [Swedish Institute for Transport and Communication Analysis (SIKA), Stockholm]; *Transport Statistics Great Britain* [Department of Environment, Transport and the Regions (DETR), London] and *Transport and Communication Statistics* (Statistik Sentralbyrå, Kongsvinger).

Furthermore, there are many unofficial national and supranational organisations that produce and/or publish transport statistics. The International Road Federation (IRF, Geneva), the International Union of Railways (UIC, Paris) or the International Civil Aviation Organisation (ICAO, Montreal) may be cited as examples of unofficial supranational bodies. Examples of unofficial national bodies with extensive multimodal and/or international transport statistical information include the German Economic Research Institute (DIW, Berlin), publishers of *Verkehr in Zahlen* (Transport in Figures) or the Association of Road Vehicle Manufacturers (VDA, Frankfurt am Main), which publishes *International Auto Statistics*.

There is therefore no lack of institutions or publications on transport statistics in Europe. On the contrary, there is a wealth of confusing information, so that it is difficult for users to obtain internationally comparable data and at times irritating, as one finds very different information supposedly on the same subject.

## What the user requires from transport statistics

Apart from users' needs with regard to content, already noted, users may also make qualitative and theoretical demands on international transport statistics. These can be listed under the following five topics: completeness of the material, accuracy of content, continuity and timeliness, transparency and user friendliness.

**Completeness** means that a transport statistics programme should cover all essential aspects of the transport sphere in the fields referred to earlier and, insofar as possible, should deal equally with all types of transport (passenger and goods transport) and modes (road, rail, waterways, sea, air, pipelines) at least at a minimal level. Emphasising certain points does not contradict this principle provided that other elements are not ignored.

**Accuracy of content** has various facets. If data are to be meaningful, it is essential that they are properly differentiated. By way of example, in planning national infrastructures, data on transport demand should be in line with the principle of "territoriality", *i.e.* they should cover traffic performed by national and foreign carriers on a given network. Data based solely on the concept of "nationality", *i.e.* traffic by national carriers inside or outside the country, are inadequate for this purpose.

Another important factor is the used of standardised definitions, as this affects data transferability. This is particularly important when the statistics of several producers are brought together,<sup>1</sup> because otherwise the geographical comparability of the data may be jeopardised. For example, levels of car ownership (private cars per 1 000 inhabitants) cannot be accurately compared at international level, if “private cars” are defined and identified differently in different countries. The definitions must provide a reliable basis for comparison.

Finally, statistics should accurately record characteristic features. It has become common practice to obtain statistics on the basis of sampling and modelling. A decisive factor is the reliability of the sample, which depends on statistical accuracy (significance or probability of error) and the extent of spatial and/or functional analysis required. At times, it is necessary to use rather broad estimates of the basic overall situation, since a foundation for extrapolation would otherwise be lacking.

**Continuity** and **timeliness** deals with user requirements with regard to time. In questions that look to the future, current planning philosophy does not rely solely on information about the past and the present, but attempts to base decisions on forecasts as well. This requires information on past developments of the variables to be forecast. This requirement is independent of forecast characteristics and methodology. Clearly, different types of forecast (*e.g.* of trends or scenarios) and different horizons (*e.g.* short- or long-term) require statistical information for different periods and frequencies. For long-term forecasts, the rule of thumb is that the periods of analysis and of forecasting should be about equal in length. Short-term forecasts usually need data covering less than a year (*i.e.* monthly or quarterly).<sup>2</sup>

For highly disaggregated information in terms of area or function, it is not absolutely necessary to collect data at very short intervals. This is particularly true when structures are not expected to change quickly. It is important, however, that surveys should not be one-off efforts but conducted at regular intervals – *e.g.* in conjunction with censuses or other in-depth enquiries such as workplace surveys – and based on standardised definitions and survey concepts. In updating models as well, it is important to obtain empirical data that can be properly checked, since the credibility of the basis for project planning would otherwise be called into question.

Lastly, statistics need to be as up-to-date as possible. Time and again, consultants and forecasters encounter disbelief when they point out that the available statistical information covers dates or periods more than six months in the past.

**Transparency** encompasses a range of user requirements to be met by the publication of (transport) statistics. Unambiguous and understandable definitions of all identified characteristics are of central importance. Even if many data users are not (any longer) used to reading the “small print”, and therefore the definitions, in statistical publications, such explanations should not be lacking in any publication, whether printed or electronic. If there are deviations from agreed definitions or changes over time or between one table and another, this must be made clear through a direct reference to the figures concerned.

The presentation of figures should also make it possible to recognise whether the data is “statistical” in the original sense (*i.e.* derived from a complete survey), extrapolated from sample surveys or based on estimates. This is all the more important where figures from surveys of different kinds or qualities are set side by side. Where results of sample surveys are reported, levels of significance should be indicated and should be clear from the data.

Lastly, where secondary data are provided, a (comprehensible) reference to the primary source should be included. While this requirement seems self-evident and trivial, it is not always observed when publications on transport statistics are drawn up.

The last (but not least important) group of user requirements is related to the *user friendliness* of statistical information on transport. An important aspect is ease of access to the required data. Anybody wishing to compare levels of car ownership across Europe (*e.g.* for the present 39 full members of the ECMT) can certainly consult 39 statistical yearbooks or surf Web pages, but this is not a user-friendly solution. As a result, there is a demand for documenting at least the most important figures in international publications, if possible as time series. The publication of time series is of great value for a broad range of transport statistics users.

A second important aspect of user friendliness has to do with maintaining at a reasonable level the costs incurred in satisfying the need for information. In this connection, time spent counts as much as the cost of preparing the information. If to compare car ownership Europe-wide, one had to buy 39 statistical yearbooks, both the cost incurred by the user and the time spent obtaining them would surely be unreasonable.

### **Current problems relating to the quality of European transport statistics**

The above-mentioned user demands for transport statistics seem justified, and may even seem trivial, but the reality of European transport statistics today is such that they are often not satisfactorily met. The following examples illustrate the need for action. They do not suggest that particular countries or institutions should be pilloried, but that problems should be brought out to provide a starting point for improvement. The examples are mainly taken from the Prognos study for the European Commission referred to above and therefore apply to passenger and freight traffic performance as well as road vehicle fleets.

As regards *completeness* of data, large gaps were found, mainly in road vehicle traffic data. In the many national sources consulted, relevant information was found for only one-third of EU countries. For some (*e.g.* Greece and most central and eastern European countries), no information was available either from national or international sources. The data that may sometimes be found result from individual studies or bold estimates by consultants, which are repeated again and again until they become "common knowledge" and almost acquire the status of official statistics. Quite often, one has to accept that such data are only available for certain vehicle classes (*e.g.* heavy goods vehicles or specific cars or motorcycles).

There is almost no record of the transport performance of pedestrians and cyclists. In the 17 western European countries investigated (EU-15 plus Switzerland and Norway), (occasional) information on cyclist traffic existed in statistical publications or surveys only for Denmark, Germany, the Netherlands, the United Kingdom and Switzerland. For pedestrians, this type of information was only found in sources for Germany, the Netherlands, Sweden and Switzerland.

The lack of data in most publications on the East German federal states prior to reunification in 1990 presents a particular problem of lack of completeness; there are good reasons for not simply adding together the East and West German figures for the period up to 1990, owing to the differences in the structures of the two former German states. It is far more difficult to understand why

many UK statistics only include information on Great Britain, with Northern Ireland being excluded. There are similar instances of geographical incompleteness for France (Corsica) and Spain (Canary Islands), although, from a statistical point of view, the latter seem more justifiable than the lack of information on Northern Ireland.

On the subject of proper definitions, the greatest deficiencies concern traffic performance. Here, however, the problems differ from one transport mode to another. In the case of passenger transport (cars, motorcycles), the information presumably comes from estimates; there is usually no indication of the actual source of the data. The estimates may be based on road traffic counts (on a given network, and therefore based on the principle of territoriality), on vehicle fleets (*i.e.* registered motor vehicles, and therefore based on the principle of nationality) as well as on energy consumption (the volume of fuel sold in a country, therefore combining the territoriality and nationality principles, since fuel can be consumed in or imported from another country). The tendency is to see these estimates as corresponding to the concept of territoriality. The same is also true of bus traffic, where definitions are less clear for coach trips, which often involve crossing borders, than for scheduled services. For rail traffic, work has mainly been done with sound information based on the concept of territoriality. In the field of air transport, the data situation is very confused and the definition of traffic very complex, which is why information on air traffic is rarely found in national statistics or even in international publications. Data provided by airlines are not related to one of the two concepts but to the companies' route networks.

For freight traffic, the situation is similarly diverse: information on railways, inland waterways and pipelines is mainly defined according to the concept of territoriality and originates from full surveys. For road freight, a change is under way. Until the end of the 1980s, countries that strictly regulated their transport markets normally provided very detailed and reliable data based on territoriality. The completion of the internal market, linked to deregulation and a breaking down of borders, led to a striking change (above all in Germany and Austria), and, in accordance with the new regulation on road freight traffic statistics (Council Regulation EC No. 1172/98 of 25 May 1998), road freight traffic data will in future be obtained by sampling specific road hauliers, in line with the concept of nationality. Data for the purpose of transport planning and modelling will only be usable in this form if they are gathered across the whole of Europe and assigned to individual territories as traffic performed by all (national and foreign) hauliers. As long as this does not happen, information on the branch of the transport sector which is currently receiving the closest attention in European transport policy will be available in the appropriate territoriality form only as rough estimates. The comments on air passenger transport also apply to air freight.

Many examples of the lack of unified definitions could be provided. Vehicle fleets produce almost as many definitions as there are sources. For private cars, differences in definition arise as a result of the inclusion or exclusion of estate cars, pick-up trucks, taxis and other vehicles. The information on Portugal is particularly hazy. In certain countries, vehicles are only reported if they are currently liable to taxation (*e.g.* in France, only vehicles less than ten years old). For motorcycles, it is often unclear which vehicles are actually included in the statistics, and there are different limits for the minimum cubic capacity shown in the statistics (*e.g.* 40 cc in Belgium, 50 cc in most other countries). There is also a lack of harmony in the way mopeds and motor-assisted bicycles are viewed. With buses, the main problems are the minimum number of seats a passenger vehicle requires to be a bus and how public transport buses are taken into account.

For traffic data, too, quite different definitions of characteristics often appear next to or above each other in the same source. Examples have already been given. Special doubts arise when figures defined differently are summarised to provide information on groups of countries. There are also problems when some data have notes which draw attention to limited comparability, while other data

do not, even though it is evident from other sources that these, too, suffer from problems of comparability. In this respect, a very critical approach should be taken to data in the IRF's publication, *World Road Statistics*; admittedly, it has an extensive annex containing "remarks", but these are by no means complete. On balance, it may be said of "unified definitions" that, with European transport statistics in their current state, a scarcely justified generosity of spirit would be needed to allow the data of different countries to be summed together.

The subject of sample surveys and their increasing significance should also be mentioned in connection with the *validity* of statistical information. To assess their results, it is vital to preface the figures with explanatory texts, which clarify the basis of the survey and the method of extrapolation. In addition, areas of uncertainty in the data should be indicated. Good examples here are the Swiss statistics, *Gütertransporte auf der Strasse, Erhebung 1993* (Road Freight Transport Survey 1993) (Bern, 1996) or the *Statistische Mitteilungen* (Statistical Notes) issued by the *Deutsches Kraftfahrt-Bundesamt*, together with the *Bundesamt für Güterverkehr* on *Verkehrsleistung deutscher Lastkraftfahrzeuge* (Traffic Performed by German Goods Vehicles)(various years), for which there is also a detailed volume on methodology.<sup>3</sup> At the very least, the user of statistics must be made to understand that rates of change between different points in time, calculated on the basis of such data, might be smaller than the uncertainties inherent in the data, so that the same phenomena subjected to a complete survey might reveal a negative rate of change rather than a positive one, or *vice versa*.

As regards the *time aspects* of user requirements, the current state of European transport statistics throws up three particularly serious problems: the failure to appreciate the need for time series, the inconsistency of definitions over time and the lack of timeliness. The lack of appreciation of time series is evident in many national statistical publications, where even the most important basic data are often only given for the most recent reporting year or for the past three or four years. Even Eurostat's data had a gaping hole for many years, ever since the publication *Transport, Annual Statistics*, which provided an overview, was discontinued. However, for a broad range of users, this gap could be satisfactorily filled by *EU Transport in Figures*.

For the user, the changes in definitions which lead to discontinuities in the time series constitute a much greater problem. It is often essential to discover, through painstaking attention to detail, why different data appear in the table for a particular year in different annual editions of the same publication. Provided there are good reasons for changing the content (*e.g.* revision of estimated data based on new surveys), this is understandable. But often even an experienced user of statistics cannot deal with the situation, and here again the IRF's *World Road Statistics* should be approached with care.

For most users, transport statistics are not timely enough. Indeed, some publications give updated information relatively quickly, but annual data are normally not available until the autumn of the following year at the earliest. The ECMT's *Trends in the Transport Sector*, which contains a selection of essential data, is issued with a delay of about 15 months, and the more detailed ECMT publication, *Statistical Trends in Transport*, last appeared in 1998 with data up to 1994 (situation as at 29 October 1999). This is all the more serious in that this is the only publication to show long time series for most European countries and the one that documents most fully the data provided by the three "Community producers" (Eurostat/ECMT/UN ECE) on the basis of their "common questionnaire". A person seeking up-to-date and comparative country transport data is at present best served by *EU Transport in Figures*. This raises the question of whether the Internet version of this brochure (<http://europa.eu.int/en/comm/dg07/tif>) will be up-dated every three months, with the result that the printed version – presumably still more widespread at the moment – might well be superseded by a more up-to-date Internet version by the time it is available.

For **transparency**, something has already been said. It is particularly important that data of different quality and changes in definitions should be clearly shown in the columns of figures. Here there are still distinct shortcomings. We fail to understand how quite different data can be published in an individual column of figures without any explanation. The IRF statistics already mentioned rarely fail to surprise; in extreme individual cases one should see whether it would not be better to refrain from publishing unsuitable data. It is always helpful, when citing a secondary source, to indicate the original source; such indications are sadly lacking in practically all international publications, at least in the eyes of the more critical user of statistics.

As regards **user friendliness**, a number of comments have also already been made. Apart from the (not too serious) weaknesses mentioned, *EU Transport in Figures* is a pioneering concept from the standpoint of a European user of transport statistics. If it helps to produce up-to-date, quality data, it could also be a way forward for the above-mentioned ECMT and UN ECE publications. In addition, the twin-track approach of the two ECMT publications (*Trends in the Transport Sector, Statistical Trends in Transport*) could be avoided, which would have the added benefit of saving resources. Speaking as consultants, the cost of the international statistics available seems very low. Statistics, like any other information, should normally cost the user something, and the price should be above the level of “token fees”. However, in that case, one would expect a significant improvement in the quality of the data.

### **Summary and overview of starting points for improving the quality of European transport statistics**

In Europe there is a great deal of data, even on the transport sector. However, the data are often not of the quality required by the users.

One of the main problems is that there is clearly insufficient co-ordination in the production of data and therefore insufficient harmonisation or comparability as well as too many sources. This seriously damages the image of (transport) statistics.

An agreed approach to an internationally co-ordinated production of transport statistics, under the overall control of Eurostat/ECMT/UN ECE, should be intensified and if possible lead to a joint publication. The co-ordination of data should not be limited to a common “Glossary for Transport Statistics” but to a convergence of collected and published data.

Today, those interested in European transport statistics are not fully catered for. They need a “one-stop shop”. They would be prepared to pay higher prices for higher quality data.

Politicians must know that their transport policy decisions are based in part on very uncertain information. For the intervention in transport affairs referred to at the outset, in particular, sound information is required to eliminate undesirable side effects. Against this background, the defensive posture adopted by many of today’s politicians towards statistics in general and transport statistics in particular is incomprehensible and counter-productive. Transport statistics must become a prime concern of European transport policy makers. In order to enlist support for this cause, producers and users of European transport statistics must act together.

## **NOTES**

1. A commendable achievement in this area is the *Glossary for Transport Statistics* prepared by the Intersecretariat Working Group on Transport Statistics, with representatives of Eurostat, ECMT and UN-ECE, Luxembourg/Paris/Geneva 1994, second edition, 1997.
2. See S. Rommerskirchen, "Langfristige Verkehrsprognosen – Gratwanderung in einem komplexen Problemgebirge", in *Internationales Verkehrswesen*, 49, 1997, No. 7+8/97, pp. 362-366.
3. Methodenband zur Reihe 8, *Verkehrsleistung deutscher Lastkraftfahrzeuge*, Sonderheft 1, Flensburg/Cologne, 1995.



## **B. CONCRETE EXAMPLES**



## **5. ROAD SAFETY AND BENCHMARKING**

*by*

**Kåre Rumar  
VTI – Road Safety, Sweden**

### **The road safety problem**

The problem of road safety has two sides. One is the social perspective and the effects for society of road accidents and their victims. What should society do to reduce the number of accidents and their effects? The other is the individual perspective. How do road accidents affect the lives of citizens? What can road users do to avoid accidents and their consequences? A further problem is the fact that what is obviously a huge problem to society is often experienced as a small problem by the individual.

#### ***Society's perspective***

The lack of road safety creates a serious public health problem in Europe. In the 40 Member countries of the ECMT, over 100 000 persons are killed on the roads every year, according to official statistics. The actual figures are even larger. In the 15 countries of the European Union, where traffic is generally more intensive, more than 60 000 persons are killed annually. In general, the trends towards greater safety are positive in western Europe and negative or less positive in central and eastern Europe.

Because EU statistics are more uniform, EU figures are used here to illustrate the situation in Europe. The number of transport accidents, injuries and fatalities gives an idea both of the absolute size of the problem and the distribution between different transport modes. Annual transport fatalities within the EU are as follows (ETSC, 1999a):

Road users	42 500
Train passengers	108
Air passengers	190
Ferry passengers	100

These figures show the extent to which road accident victims dominate, accounting for about 99% of fatalities. However, they tell only part of the story. To understand the factors behind their level and their rise or decline, it is necessary to look at exposure to the various transport modes. Taking the

ratio of fatalities to exposure, it is possible to calculate the risk presented by a given transport mode. There are several ways to indicate the amount of exposure, such as number of persons or vehicles, time spent in the activity, distance travelled with that transport mode, etc.

Using time as the measure indicates that the risk of fatality per hour is about 40 times higher for road transport than for all employment activities taken together and about 12 times higher than for home activities (ETSC, 1999a). Another result shows that for persons under 45 years, the road transport mortality rate is higher than for any disease, including cancer and heart disease. The fact that road fatalities, unlike most other causes of death, primarily concern young persons also means that the number of lost years and the economic costs are higher for road fatalities than for any disease.

Using distance travelled as the exposure measure gives what could be called the mortality rate for each mode of transport. The risk picture remains dominated by road transport:

Road user	113 fatalities per 100 million kilometres
Train passenger	0.3 fatalities per 100 million kilometres
Air passenger	0.5 fatalities per 100 million kilometres
Ferry passenger	0.3 fatalities per 100 million kilometres

Much transport consists of a combination of different modes, including walking, cycling, driving, travelling by bus, train or plane. To estimate the total risk presented by a trip, it is necessary to combine the risks of the various modes. In Table 1, transport risks for the various modes are calculated per distance and per time.

**Table 1. Fatality risks for each transport mode in the EU**

Mode	Sub-mode	Per 100 million person-kilometres	Per 100 million person-hours
Road	Total	1.1	33
	Bus	0.08	2
	Car	0.8	30
	Foot	7.5	30
	Cycle	6.3	90
	Motorcycle/moped	16.0	500
Train		0.04	2
Ferry		0.33	10.5
Plane		0.08	36.5

*Source:* ETSC, 1999a.

Train transport is clearly the safest transport mode per kilometre, closely followed by bus and plane. Cars are ten times safer than walking but also ten times less safe than buses. The most dangerous transport mode is motorcycle/moped, followed by cycle. The risk of flying is related to the number of takeoffs and landings. Somewhat surprising is the result that the risk of ferry transport is four times that of planes and eight times that of trains. The explanation is probably that the number of fatalities for each ferry accident with fatalities is very high.

Based on these risk assessments, safety should be improved for walking, bicycling and moped/motorcycling. High-speed trains should be used instead of air transport on many trips within Europe, as air is only safer on distances greater than about 1 600 kilometres.

As the largest differences among European countries are found in road transport and rail transport, work is needed in this area. For individuals, there is a difference of a factor of four between the safest and the least safe western and central European country (IRTAD, 1998). However, because of the co-variation between the level of safety and motorisation there is a difference of a factor of eight in terms of fatalities per vehicle-kilometre driven. In other words, if the public health problem is high, the risk per kilometre is even higher. This suggests the utility of a benchmarking exercise.

Fatalities are used here because permanent impairments and serious injuries in different transport modes are not reliably registered. This is not an acceptable situation and should be changed. Another observation (ETSC, 1999a) is that registration of fatalities and exposure data for various transport modes (especially sea and rail) are unreliable.

Such statistical data are necessary to carry out benchmarking, because without them it is impossible either to establish the size of the problem or to make comparisons between countries or regions. Another important use of such data is to follow up measures taken. Without such follow-up, nothing is learnt from road safety work. The most needed data concern exposure figures of various transport modes.

### ***Individual perspective***

Transport injuries and fatalities are often treated as a price to be paid to maintain our high level of mobility. However, as Table 1 shows, transport accidents in general and road accidents in particular result in injuries and fatalities which constitute a public health problem whose dimensions few decision makers and very few road users realise. The figures are there, but most readers of statistics do not recognise their significance. Most people believe that road accidents happen to others, not to them.

The figures in Box 1 are presented in a way that is more difficult to ignore. They take not society but the individual as a basis and make clear the size of the road safety problem for society and citizens. In Europe, injuries from road accidents are a considerable public health problem.

#### **Box 1. The public health problem resulting from road traffic accidents in a number of European countries**

- 1 citizen in 3 will need hospital treatment during their lifetime as a result of road accidents.
- 1 citizen in 20 will be killed or impaired by road traffic accidents.
- 1 citizen in 80 will die 40 years too soon as a result of road traffic accidents.
- Road accidents shorten life expectancy by 6 months.
- Road accidents cause on average 2.5 years of health loss.
- The injury risk per unit of time is 40 times higher on roads than in industry.
- Contrary to other causes of death, road accidents kill more young people.
- Road accidents are the largest single cause of death for persons under 45.
- Road accidents cause the highest number of lost years of any cause of death.

*Source:* ETSC, 1999a.

Clearly, road injuries and fatalities are a problem not only for society but also for the individual. However, society clearly perceives the problem, while the individual road user normally does not experience safety problems. For instance, increased speed on a specific road immediately results in a statistical increase in crashes, injuries and fatalities. On the other hand, the driver can press the accelerator, increase his speed considerably and only notice that he arrives at his destination quicker. Because of this difference in perspective, authorities and road users do not understand each other.

Yet, the road safety problem can never be solved by the authorities alone. Co-operation between road users, the authorities and the trade and industry is needed. Not until such co-operation exists can there be effective road safety work.

### **Benchmarking in the road safety sector**

Benchmarking does not appear to be really used in road safety work, where, however, technology transfer is a common concept. It means that one party (for instance a country) learns from the experience of another (country or region, for instance). A major problem in technology transfer is that, owing to differences among countries, transfer of experience is often very difficult or even impossible.

Benchmarking appears to have much in common with technology transfer but takes the process a step further. To avoid transfer problems, it is necessary to match or calibrate the two parties in various ways. This requires statistical data not only on accidents but also on a number of basic variables such as road quality, vehicle population, vehicle density, level of education and economic situation. However, the basic process seems to be the same and it must be possible to use trials, experience and strategies and countermeasures from one country or region in other countries or regions.

The first benchmarking variable is to identify road safety problems. This constitutes an important step towards resolving them, but it is also necessary to define and understand further aspects of the problems.

### **Three levels of road safety problems**

One general approach, which seems to be fruitful, is to split road safety problems up into three types (Rumar, 1999):

- Problems obvious even at a superficial analysis (first-order problems).
- Problems revealed by a somewhat deeper analysis (second-order problems).
- Problems that are almost totally hidden (third-order problems).

First-order problems are common to many countries, but their solutions may be very different and it is hard to take the experience from one country and apply it directly in another (*e.g.* drinking and driving, wearing of motorcycle and bicycle helmets). Second-order problems are also common, but here experience and results in one country are probably easier to apply in others. The benchmarking problem for third-order problems is to detect and identify them. However, taking experience from one country and applying it to another should not present a problem.

## ***First-order problems***

First-order road safety problems are those that come out directly in the analysis of accident and injury statistics. Accident and injury statistics are collected, organised and analysed differently from country to country. Most European countries, however, share a number of common first-order problems and give them very high priority. While the ranking of problems is not always the same, they are problems which all countries try to resolve.

Countries differ in that the problems may be different and criteria for giving a problem high priority may differ. They may focus on numbers of fatalities (*e.g.* young drivers), numbers of injured or number of accidents (*e.g.* built-up areas), high risks based on some calculation (*e.g.* motorcyclists), negative trends (*e.g.* drugs and driving or elderly drivers), road users who cannot themselves reduce the problem (*e.g.* children, the elderly).

Consequently, it is almost impossible to give a general ranking of the most important first-order road safety problems in Europe. The following unranked and largely overlapping list would appear to constitute a group of common top-priority direct road safety problems in most European countries:

- Speed is excessive, especially in built-up areas.
- Alcohol and drugs are too frequent in road traffic.
- Road safety is insufficient in urban areas.
- Road safety of children is inadequate.
- Road safety of unprotected road users is insufficient.
- The accident risk for young drivers is too high.
- Driving of cars is too widespread, especially in urban areas.
- Road and street standards are inappropriate in many places.
- Accident and injury risks for elderly road users are too high.
- Too many roads and vehicles are inadequate from the point of view of injury prevention.
- Use of protective devices (belts, helmets, etc.) is too low.
- Rescue service and medical treatment of traffic victims is not effective enough.
- Road users are not visible enough in daylight and are far less visible at night.
- Risk of accidents is too high when visibility is reduced (*e.g.* darkness, fog).
- The risk of accident in winter traffic is too high.
- Heavy vehicles are over-represented in serious accidents.
- Accidents risks are too high at some types of intersection.

Among these first-order road safety problems, speed is the most important (ETSC, 1995). Some of the reasons are:

- Speed affects both the risk and consequences of accidents.
- The effect of speed on safety is exponential.
- Speed is not recognised as a danger factor.
- Speed is a key behavioural variable because driving is a self-paced task.
- Reduction in speed has an immediate effect on safety.
- Reduction of speed is an inexpensive (sometimes even beneficial) measure.

## ***Second-order problems***

Second-order road safety problems are not as obvious but show up on closer analysis of first-order problems. One way of defining them is to say that they reduce the effectiveness of countermeasures aimed at solving first-order problems. Examples of second-order problems are:

- Road traffic rules (legislation) are unclear, illogical and inconsistent.
- Enforcement of traffic rules and license requirements are not effective enough.
- Training and examination for a driver's license are inadequate.
- Traffic safety education of citizens is inadequate.
- There is insufficient control of road conditions from the point of view of safety.
- There is insufficient control of vehicle conditions from the point of view of safety.
- Treatment of traffic offences and crimes in courts is inconsistent and not commensurate with the corresponding risks.

## ***Third-order problems***

By third-order (hidden) road safety problems are meant problems that are not easily recognised when studying accident or injury statistics. They are often of a more general character and deal not directly with the traffic situation but with underlying processes or conditions related to the organisation of road safety work, such as central or distributed responsibilities, decision processes, resource management, co-ordination and management of road safety work. They may also concern the awareness of the value and the knowledge of road safety measures among the members of society - decision makers, road safety workers as well as roads users.

Third-order road safety problems prevent possible solutions to the first- and second-order problems. Solutions to third-order problems would facilitate the use of much current knowledge of effective countermeasures which are not implemented for one reason or another.

On the one hand, most people place the main responsibility for road safety on governmental or at least on public bodies. On the other, when an accident occurs the road user is usually blamed. To a large extent, this paradoxical situation will remain. However, it is necessary to make the division of responsibilities between individuals and the public sector much clearer. The role of road users should be to follow the rules, formally as well as in spirit, and to demand more road safety actions. Unintentional mistakes should not lead to the user's death.

In the future, trade and industry are likely to play a much more important role. Today, many progressive communities and companies have developed and introduced environmental policies and plans for their implementation. In the future, communities and companies should develop corresponding road safety plans. For instance, when purchasing transport, part of the specification should address safety aspects of the transport itself. This is fairly self-evident for transport of school children, but the same should be true for bus transport in general and for transport of goods. Such policies would have a very strong and immediate impact on road safety.

Similarly, consumers could use transport products better if they had the means to evaluate the safety of various products. The car itself is the most obvious and important product. By testing, rating and publishing the active and passive safety factors of various models, it would be possible to influence the safety of the vehicles faster, more effectively and less expensively than by the traditional legislative means (EURO NCAP, 1998).

Some of the more important third-order road safety problems are:

- Awareness of the seriousness of road safety problems and of the value of road safety measures is too low among decision makers and road users, with many negative effects. In particular, it prevents implementing existing knowledge about how to reduce road safety problems. A main reason for this low awareness is differences in perspectives on road safety (Rumar, 1988).
- The present system for managing road safety work is inadequate. It is slow and inaccurate at best and in many cases almost non-existent. Efficient road safety management needs to be based on performance indicators (Rumar and Stenborg, 1994).
- When it is possible to create a vision of the future which most people in society or in a company stand behind, this is the most efficient way to go in the right direction and to engender creativity, energy and participation. EU road safety work lacks a good vision. Sweden has adopted a zero-fatality vision that seems to work better than expected (SNRA, 1996).
- Quantitative targets are at least as important as qualitative visions. Experience shows that quantitative targets at national, regional and local level help road safety work to succeed (OECD, 1994)
- The present road safety information and diagnosis system is very primitive and somewhat inaccurate. In most countries, it is exclusively based on accidents reported to the police. Because road accident injuries and fatalities are a public health problem, the system should be able to measure the health problem. To do so, hospital statistics must be better used.
- Every country is carrying out extensive road safety research. It is a complex, demanding and expensive process. There is fairly good co-operation among researchers, but very limited co-operation among financiers of research. This leads to differences in the material required for decisions and unnecessary differences in decisions. Road safety research within the EU should be better co-ordinated. Research on first- and second-order problems is quite extensive, but research on third-order (implementation) problems is very limited and should be expanded.
- Consumers, communities and companies must become more actively involved in the road safety effort. If they are, they will be a strong and powerful force to influence and improve road safety.

The third order road safety problems are not as eye-catching as the first- and second-order road safety problems. They are, however, probably more important for European road safety work (especially in central and eastern Europe) for the following reasons:

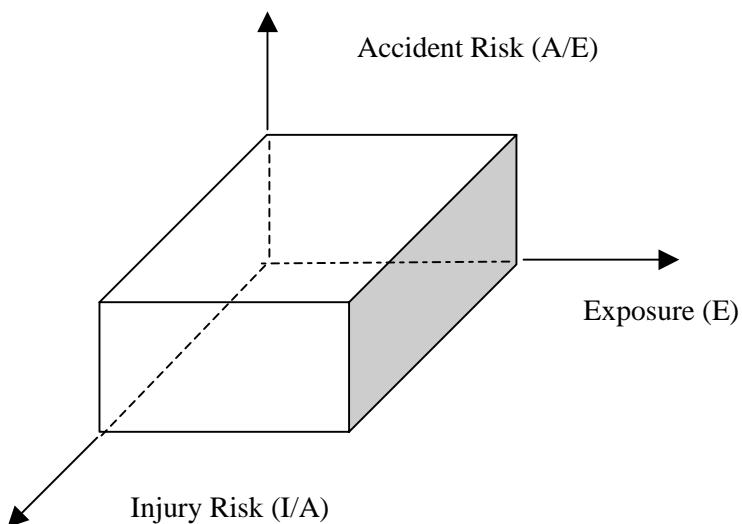
- First- and second-order problems immediately lead to countermeasure questions and answers. Third-order problems face implementation difficulties.
- While people are aware of first- and second-order road safety problems, they are unaware of third-order problems.
- First-order problems are relatively narrow and second-order problems are relatively broad. If some third-order problems are solved, the whole road safety process will be affected.

## The countermeasure principles

The second basic benchmarking variable is choice of countermeasures (Rumar, 1999). It is important that all three principles mentioned are applied. Historically, the focus has been on accident prevention, but experience shows that reducing traffic accidents and injuries is at least as effective as trying to prevent them.

From public health point of view, three basic variables, representing countermeasures, determine the size of the road safety problem. In Figure 1, the volume represents the total number of persons killed or injured in road traffic (I).

Figure 1. **The safety problem (human injury) illustrated by the volume of the box**



*Note:* The volume (I) is a function:  $I = E \times A/E \times I/A$ .

One countermeasure involves *exposure to road traffic* (E), as many studies show a very strong correlation between traffic volume and number of accidents. The problem is to reduce traffic volume without losing too much mobility. Relatively few nations have worked on this, although road safety proponents and road environment proponents have a common interest and should support each other on this issue.

This is probably the variable with the greatest potential for influencing safety from the point of view of both volume and time. Economic depressions are generally associated with increased road safety, and this has very much to do with the reduction of traffic volume, primarily among young drivers. If a volume-influencing measure is introduced, it will have immediate effect.

Real use has not been made of this safety-influencing dimension. However, it will most certainly have to be used more frequently in future, for environmental if not for safety reasons. New transport telematics will make it possible to reduce exposure more intelligently without excessively impairing mobility.

Another countermeasure involves the *risk of accident for a certain volume of traffic* (A/E). The general problem here is to find measures that will reduce the risk of accidents in high-risk situations such as darkness, fog and ice, and for high-risk groups such as young drivers, unprotected road users, heavy trucks, etc. This is the area that has attracted the greatest interest and the most effort and resources.

Measures to reduce the risk of accidents may take several forms. It is possible to reduce risk by improving road users' knowledge and attitude, drivers' experience and skill, vehicle performance, road characteristics, traffic legislation and enforcement strategies, either as single or integrated measures. There is considerable knowledge about how to lower various risk factors. However, while this is often called active (preventive) safety, it is on the whole not very successful.

The main reason is that this type of measure for reducing accident risks is often strongly affected by the adaptive (compensatory) behaviour of users. Several studies have shown that the technical effect of countermeasures are reduced because users, *e.g.* drivers, use improved visibility, friction, braking performance, road geometry, driving skill, etc., primarily to improve mobility or comfort, not safety. Most often, they react by increasing their speed.

The third countermeasure involves what can be called the consequence variable, *i.e. the risk of injury, given an accident* (I/A). The general problem is to find out how to reduce the injury level in accidents of various types: head-on collisions with cars, side collisions, collisions between car and truck, collisions between car and unprotected road user, single-vehicle accidents, bicycle accidents, etc. Road safety audits are a promising way of finding and removing injury-causing elements along roads. This area has attracted considerable interest and met with substantial success over the last decades.

Contrary to measures aimed at reducing the risk of accident, this countermeasure often succeeds. The main reason is that adaptive counteraction is normally avoided. Drivers do not feel, do not get feedback from, passive safety features. Consequently, behaviour such as increased speed is largely avoided.

The total number of those killed, impaired or injured in road traffic is obtained by multiplying the three types of countermeasure:  $E \times A/E \times I/A = I$ .

## **Failures in previous road safety work**

The third benchmarking variable is identification of major mistakes in previous road safety work (Rumar, 1999). To understand how road safety work should be carried out successfully in future, it is necessary to analyse how it was carried out in the past and the results obtained.

## ***Unclear roles of road safety actors***

In too many countries, the distribution of tasks and responsibilities between administrations and other organisations active on the road safety scene is unclear. There are four main actors: road users (everyone is a road user, by foot, bicycle, public transport or car); authorities (local, regional, national and international); voluntary organisations and trade and industry.

Looking back, one may see how badly roles and responsibilities among these four groups and within these four groups have been organised. Some areas of traffic safety are covered by several actors while others are covered by none.

### ***Management by activities***

In most countries, road safety work is mainly managed by activities. For example, it is decided that owing to an increase in accidents, a campaign should be launched, enforcement by police should be strengthened or legislation should be changed. This type of management is relatively weak and inefficient. Commercial companies have largely dropped this type of management and moved to what is called result management. They use results instead of activities as the basis for management.

### ***Lack of control of exposure***

As noted above, the road accident and injury rate has been controlled, but the public health problem created by those injured and killed in road accidents is increasing. One of the main reasons is that exposure to traffic is increasing faster than the reduction of risks of accidents and injury. At present, the number of cars is increasing faster than the number of persons.

It will not be possible to improve road safety radically until control of exposure is one of the instruments used. In addition, road traffic is a major source of the world's environmental problems (the greenhouse effect). Road safety proponents should join environmentalists in their effort to control exposure without losing too much of the mobility and flexibility offered by motorised traffic.

A specific aspect of the exposure problem is the wish to move transport to the safest roads and to the safest transport modes. Intelligent debiting systems may be a way to achieve this.

### ***Too many centralised decisions***

In most countries, decisions about road safety work are mainly carried out on at central level. As a result, citizens do not consider this their business. This opens a gap between the authorities and the public, who are the road users. In other areas of society, when people feel that they can influence their situation, they become much more interested in solving problems.

The gap is widened by the fact that the road safety problem looks very different to the authorities and to the individual road user. Any driver takes a microscopic risk in every trip but forgets that he is travelling every day, every week, every month, every year of his life. Together, all these microscopic risks add up to quite a sizeable risk. Every road user may violate a rule and find that instead of being punished he benefits.

### ***Too detailed planning of future road safety actions***

In principle, there are two ways to make a process work and to reach a defined goal. One way is to plan everything in detail and makes rules. The other is to describe the goal simply and clearly and to make the goal very visible – to create a vision.

The top-down planning strategy is the old way to address a problem. Administrations have traditionally taken this approach for road safety as elsewhere. The vision strategy is a much more

modern approach and has been used quite extensively by commercial companies with the staff working together towards a common goal without too much detailed instruction.

The more complicated the process, the more difficult it is to adopt a pure planning strategy, and the more appealing the vision strategy. The problem and organisation of road safety are very complex, with many independent variables and many quite poorly co-ordinated actors.

### ***Lack of quantitative road safety targets***

The report *Targeted Road Safety Programmes* (OECD, 1994) gives a very good review of practices, purposes and effects of setting quantitative targets in road safety work. It shows convincingly how specific quantitative goals lead to more realistic traffic safety programmes, better use of public funds and other resources, and improved credibility for those involved in the traffic safety work. The European Traffic Safety Council argues strongly for quantitative road safety targets (ETSC, 1997).

### ***Unclear strategies for reaching targets***

A number of clear road safety targets is not enough. Also needed is a strategy for reaching them which explains the actions to be taken in terms of exposure, risk reduction and injury reduction. It must be based on identification of the first-, second- and third-order road safety problems. At the same time, it must be clear, transparent and easy to understand.

A vision, clear targets and a strategy, together with a road safety management system, constitute the main points in a road safety programme.

### ***Separate budgets for costs and benefits of road safety measures***

A major problem with road safety work is that suggested actions are perceived as pure costs by decision makers. The reason is that the benefits, in terms of reduced numbers of fatalities and injuries and lower administrative and material costs, are part of another budget. Consequently, there is no economic incentive associated with road safety measures.

### ***Low awareness of the need for increased road safety***

A major problem for efficient road safety work is the fact that, for reasons noted above, the public normally does not realise the size and seriousness of the road safety problem. Systematic information and education are needed. If the public is unaware of the problem, decision makers hesitate to act, because if the gap between decision makers and the public is too large, decision makers will soon be out of office.

Therefore, both the public and decision makers need to be aware of the seriousness of road accidents and the need for road safety measures. Education is necessary throughout life, not only in connection with driver education, training and licensing.

### ***Low participation of the private sector in road safety work***

As stated above, road safety work is generally considered to be the task of the authorities. However, to be effective and successful, the public and the private sector (industry, transport companies, trade) have to be actively involved.

So far, the private sector has been involved in the development and trade of road safety products and as sponsors of road safety campaigns. They should also be involved in efforts to influence road user behaviour, the weak point in all road safety work.

### ***Lack of marketing of necessary road safety measures***

If the public reacts negatively to a given road safety measure, the public needs to be convinced. It is necessary to market the “product” using the knowledge that commercial companies have gained over the years and which has been little used by the public sector.

Every road safety measure is perceived to have a certain benefit but also to require a certain sacrifice. If the size of the benefit is perceived to be larger than the sacrifice, then there is really no problem. However, if the sacrifice required is perceived to be larger than the potential benefit, the public’s reaction is naturally negative.

The task is to change public perceptions in such a way that traffic safety proposals are perceived to entail larger benefits than sacrifices. This is not an impossible task. Both the public and the decision makers earlier rejected many traffic safety measures that are now accepted.

### ***Obsolete technology***

A growing proportion of modern cars are equipped with electronic and semi-intelligent systems (in the motor, in brakes and suspension, in instrumentation, in communication). Also, traffic control systems (traffic signals, variable message signs, radio) more and more use information technology. This advanced technology could and should also be used for road safety purposes (ETSC, 1999b).

### ***Lack of follow-up and evaluation of road safety measures***

Evaluation, feedback and monitoring of the effects of various road safety measures are very important because learning is otherwise more accidental than systematic. Mistakes can be repeated and ineffective measures used again.

There are two types of evaluation. One, at national and regional level, compares the actual situation with the specified targets. Some independent body, such as a university group, should carry out this type of evaluation of road safety work. The other type has to do with the effectiveness of the road safety work itself at any given moment. For this type of evaluation, variables other than accidents and injuries are needed. Normally, behavioural measures are used, such as use of seat belts, bicycle helmets, proportion of drunk drivers, proportion of drivers exceeding the speed limit, time needed to rescue accident victims, proportion of drivers running stop lights, etc.

## **Conclusions and recommendations**

No systematic benchmarking work appears to be carried out in the area of road safety. Two organisations which have touched upon this problem and produced some valuable documents are the OECD and the Road Safety Committee (C13) of PIARC (World Road Association). The EU has, in its latest road safety programme, indicated the need for a better information system. This is a necessary but not sufficient step towards benchmarking. The ETSC has just started an activity in the area of road safety performance indicators. Performance indicators are a prerequisite for an effective benchmarking activity in the area of road safety. Outside Europe, Australia is probably the country with the most experience that could be used for benchmarking purposes.

Considering the dominant role of road transport in transport safety, all but one of the following recommendations deal with road safety. Benchmarking for road safety means adopting these recommendations, which have been tried and proved effective in some countries. Considering present trends, the need for action seems especially urgent in central and eastern Europe.

- Treat road transport injuries and fatalities as a public health problem and use health statistics more extensively to diagnose the situation and evaluate the effect of various road safety measures.
- Carry out road safety work in all three countermeasure areas (reduce traffic exposure, reduce the probability of an accident, reduce the injuries due to accidents) and in terms of behavioural principles (selection, influence, technical adaptation).
- Be aware that the human reactions to actions are crucial for the success of accident prevention measures. Try to create road conditions which users can handle and are motivated to use safely. Try to design vehicles that are easy to handle.
- Human error can never be totally avoided. Make sure that when errors occur, violence to the human body is within its tolerance limits. Here road and vehicle design are equally important.
- Focus much effort on creating high awareness of the importance of road safety work because low awareness will limit the effectiveness of all other measures and actions. An efficient enforcement system will always be needed for road safety measures that are not fully accepted.
- Formulate a national road safety vision which is at the same time simple and easy to communicate and not too unrealistic. Specify quantitative injury and fatality targets to be reached at set times (three to five years).
- Increase public/private partnerships. One promising possibility is to make safety (of vehicles and drivers) a competitive variable in the bid for transport contracts first on the public and then on the private market.
- For reasons given above, cost and benefit budgets for road safety measures should be more closely linked. Some pilot trials have started, but much more should be done.
- In some problem areas (*e.g.* speed, alcohol) knowledge is good. It is important to concentrate on how to implement focused measures.
- In other problem areas (*e.g.* road safety awareness, intelligent transport systems), knowledge is still limited. Here the focus should be on co-operative research.

- The single most important first-order road safety problem to be dealt with is speed. It will take some time before all roads and all vehicles are built to forgive human error at high speeds. Until then speeds will have to be reduced in many areas. European countries should set certain speed limits (30 km/h, 50 km/h, 120 km/h).
- The second most important first-order problem is alcohol and drugs. European countries should set ceilings at certain blood alcohol content (BAC) levels (<0.5, <0.2 per mille).
- Among second-order problems, traffic enforcement and driver training and licensing are most important.
- To implement a result management system a number of road safety performance indicators are needed. These measures, which are normally behavioural in character, will serve as quick and simple indicators of the success of road safety work and how it could be improved.
- Modern information technology should be much more used to improve road safety than it is today. ETSC (1999b) makes a number of suggestions. Some promising applications are:
  - Intelligent speed adaptation (ISA).
  - Intelligent surveillance and enforcement systems (policing).
  - Emergency notification systems (Mayday).
  - Intelligent incident detection systems.
  - Systems that check drivers' right to drive (intelligent driving license) and monitor drivers' condition (*e.g.* alco-lock).
  - Intelligent driver self-learning systems.
  - Intelligent exposure control and road debiting systems.
- Legislation has been the primary tool used in international road safety work (*e.g.* vehicles, signs, traffic signals). Legislation to specify minimum requirements from the safety point of view will always be needed. However, in future, greater use of quicker, more up-to-date ways to influence consumers at individual and overall level will be needed. Agreed tests and consumer information are very promising and powerful ways to do so.
- Learning requires feedback. Without follow-up of road safety work, there is a risk of repeating the same mistakes over and over again. Specific follow-up should take place in the management system, but a more general follow-up of the whole process and of the responsible administration is needed and should be carried out by an independent organisation.
- Improve accident and injury information in ship, rail and air transport. Both exposure data and reliable injury and fatality data are lacking. Without such data it is not possible to compare the safety of different transport modes.
- Finally, the results of past and present road safety benchmarking activities should be summarised and synthesised. This task should be given to an international or national road safety organisation. The next step in the effort to establish a benchmarking process for road safety work should be decided on the basis of that review.

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**6. ARE WE MOVING IN THE RIGHT DIRECTION?  
INDICATORS FOR TRANSPORT AND ENVIRONMENT INTEGRATION  
IN THE EUROPEAN UNION**

*by*

**Ann Dom  
European Environment Agency, Denmark**

This paper summarises the findings of the first indicator-based report developed under the Transport and Environment Reporting Mechanism (TERM). Seven questions regarded by EU policy makers as central to understanding whether current policy measures and instruments influence transport/environment interactions in a sustainable direction are addressed:

1. Is the environmental performance of the transport sector improving?
2. Are we getting better at managing transport demand and at improving the modal split?
3. Are spatial and transport planning becoming better co-ordinated so as to match transport demand to the needs of access?
4. Are we improving the use of transport infrastructure capacity and moving towards a better-balanced intermodal transport system?
5. Are we moving towards a fairer and more efficient pricing system, which ensures that external costs are minimised and recovered?
6. How rapidly are improved technologies being implemented and how efficiently are vehicles being used?
7. How effectively are environmental management and monitoring tools being used to support policy and decision making?

This paper presents some key indicators to illustrate the most important trends addressed by these questions in various policy areas. Table 1 gives an overview of the 31 indicators that form the core of TERM.

While environmental regulations (such as vehicle and fuel-quality standards) have led to progress in certain areas, it is not sufficient to meet international and national environmental targets. Greater policy impetus is needed to redress current trends in environmental impacts from transport and to reduce the link between transport demand and economic growth. However, demand management, accessibility and eco-efficiency are not yet sufficiently reflected in EU transport policies and targets.

Although the first TERM report focuses mainly on EU developments, important lessons can also be learnt from comparisons of national performance, which can yield interesting information regarding the effectiveness of various policy measures. It is therefore intended to develop TERM into a benchmarking tool for this purpose. Table 2 is a first attempt at comparing national performance, giving a qualitative evaluation of indicator trends for a number of “integration” objectives.

There are several common features at Member State level. In most countries, for example, transport demand, energy consumption and CO<sub>2</sub> emissions are increasing. The modal mix is increasingly biased towards road transport, and air transport is also expanding rapidly to the detriment of more environmentally friendly modes. There are, however, substantial differences in approach to delivering transport systems that better address sustainability concerns. For example, Nordic countries make greater use of taxes, pricing mechanisms and land-use planning than countries in southern Europe. Countries such as Austria, Denmark, Finland, the Netherlands and Sweden have developed environmental action plans and set national targets for the transport sector. Some countries have also established conditions for carrying out strategic environmental assessments of certain transport policies, plans and programmes. This enhances the integration of environmental issues and ensures the involvement of environmental authorities and the public in decision making.

The selection of indicators was made following consultation with various Commission services, national experts, other international organisations and researchers. The indicators cover the various elements of the DPSIR analytic framework (Driving forces, Pressures, State of the environment, Impacts, Societal Responses), which the EEA uses to show the connections between the causes of environmental problems, their impacts, and society's responses to them, in an integrated way.

The indicator set is still evolving but corresponds to some extent to the long-term vision of what an “ideal” indicator set should look like. It includes some indicators which cannot as yet be quantified, as a result of data limitations. Therefore, the indicators presented in the first TERM report do not always fully match the proposed list. Where data availability prevented an EU-15 analysis, national examples or proxy indicators were used.

Table 1. Envisaged TERM indicator list (key indicators in bold)

Group	Indicators	Position in DPSIR	When feasible	Data quality
<b><i>Transport and environmental performance</i></b>				
Environmental consequences	Final energy consumption and primary energy consumption in transport, and share in total (fossil, nuclear, renewable) by mode	D	++	+
	<b>Transport emissions and share in total emissions of CO<sub>2</sub>, NOx, NMVOCs, PM<sub>10</sub>, SOx, by mode</b>	P	++	+
	Exceeding of air-quality objectives	S	++	+
	Exposure to and annoyance by traffic noise	S and I	--	--
	Influence of infrastructure on ecosystems and habitats (“fragmentation”) and proximity of transport infrastructure to designated areas	P and S	-	-
	Land taken by transport infrastructure	P	+	+
	Number of transport accidents, fatalities, injured, polluting accidents (land, air and maritime)	I	++	-
Transport demand and intensity	<b>Passenger transport (by mode and purpose):</b>	D	++	-
	• Total passengers			
	• Total passenger-km			
	• Passenger-km per capita			
	• Passenger-km per GDP			
	<b>Freight transport (by mode and group of goods):</b>	D	++	+
	• Total tonnes			
	• Total tonne-km			
	• Tonne-km per capita			
	• Tonne-km per GDP			

Group	Indicators	Position in DPSIR	When feasible	Data quality
<b>Determinants of the transport/environment system</b>				
Spatial planning and accessibility	<b>Average passenger journey time and length per mode, purpose (commuting, shopping, leisure) and territory (urban/rural)</b>	D	-	-
	Access to transport services: • Number of motor vehicles per household • Percentage of persons in a territory with access to a public transport station within 500 metres	D	-	-
Transport supply	Capacity of transport infrastructure networks, by mode and by type of infrastructure (motorway, national road, municipal road, etc.)	D	+	-
	<b>Investments in transport infrastructure per capita and by mode</b>	D and R	++	+
Price signals	<b>Real passenger and freight transport price by mode</b>	R	-	-
	• Fuel price • Taxes • Subsidies • Expenditure for personal mobility per person by income group • Proportion of infrastructure and environmental costs (including congestion costs) covered by price	D	++ - - + -	+ - - - -
Technology and utilisation efficiency	<b>Overall energy efficiency for passenger and freight transport (per passenger-km and per tonne-km and by mode)</b>	P/D	-	-
	Emissions per passenger-km and emissions per tonne-km for CO <sub>2</sub> , NOx, NMVOCs, PM <sub>10</sub> , SOx by mode Occupancy rate of passenger vehicles Load factors for road freight transport (LDV, HDV) Uptake of cleaner fuels (unleaded petrol, electric, alternative fuels) and numbers of vehicle using alternative fuels Vehicle fleet size and average age Proportion of vehicle fleet meeting certain air and noise emission standards (by mode)	P/D D D D D	- - + ++ +	- - - + +
Management integration	<b>Number of Member States implementing an integrated transport strategy</b>	R	+	-
	Number of Member States with national transport and environment monitoring system Uptake of strategic environmental assessment in the transport sector Uptake of environmental management systems by transport companies Public awareness and behaviour	R R R R	+	+

D = Driving forces; P = Pressures (environmental); S = State of the environment; I = Impact;  
 R = Response (societal).

When: ++ now; + soon, some work needed; - major work needed; -- situation unclear.

Data quality: ++ complete, reliable, harmonised; + incomplete; - unreliable/not harmonised; -- serious problems.

**Table 2.** Qualitative evaluation of key indicator trends

Integration question	Key indicators	Integration objectives	Evaluation of indicator trends														
			A	B	D	DK	E	F	FI	GR	I	IRL	L	Nl	P	S	UK
1	Emissions of: CO <sub>2</sub> NMVOCs NOx	Meet international emission reduction targets	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
2	Passenger transport	Decouple economic activity and passenger transport demand	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
		Improve shares of rail, public transport, walking, cycling	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
	Freight transport	Decouple economic activity and freight transport demand	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
		Improve shares of rail, inland waterways, short sea shipping	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
3	Average journey length for work, shopping, education, leisure	Improve access to basic services by environmentally friendly modes	?	?	☺	☺	?	?	?	?	?	?	?	?	?	?	?
4	Investments in transport infrastructure	Prioritise development of environmentally friendly transport systems	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
5	Real changes in the price of transport	Promote rail and public transport through the price instrument	?	?	?	☺	?	?	☺	?	?	?	?	?	?	?	?
	Degree of internalisation of external costs <sup>1</sup>	Full recovery of environmental and accident costs	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
6	Energy intensity	Reduce energy use per transport unit	?	?	☺	☺	?	☺	?	?	☺	?	?	☺	?	☺	?
7	Implementation of integrated transport strategies <sup>1</sup>	Integrate environment and safety concerns in transport strategies	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺

☺: Positive trend (moving towards objective); ☺: some positive development (but insufficient to meet objective); ☹: unfavourable trend (far from objective);

?: quantitative data not available or insufficient.

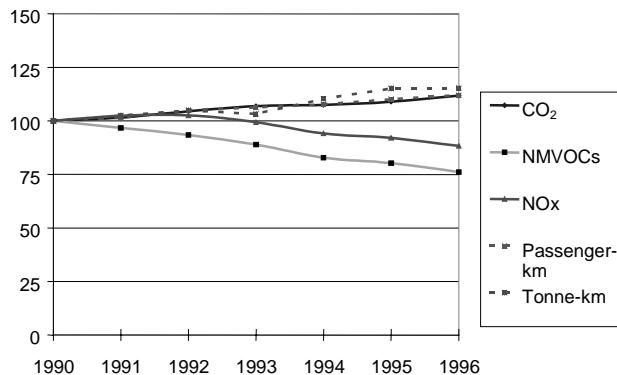
1. No time series available: evaluation reflects current situation, not a trend.

This evaluation is made mainly on the basis of indicator trends. As there is an inevitable time lag between policy development, implementation and the appearance of effects in the indicator trends, a “negative” trend does not necessarily mean that no positive policy developments are taking place to change these parameters. Monitoring these key indicators is the first step towards managing current and future policy measures. For example, tracking user prices, as is done in the United Kingdom and Denmark, is essential to manage measures to promote fair and efficient pricing.

## Integration question 1. Is the environmental performance of the transport sector improving?

### Key indicator: Emissions from transport (EU-15)

Index (base year 1990)



Source: EEA/ETC-AE/Eurostat.

### Key message

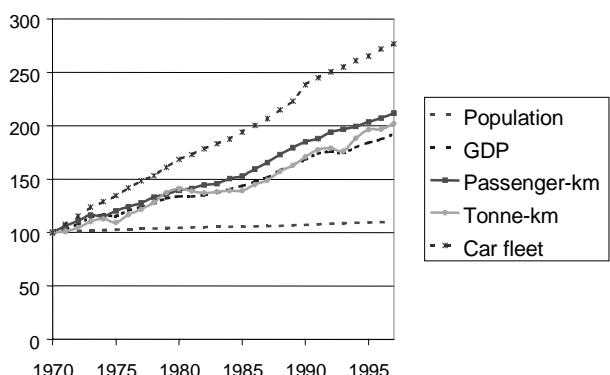
Transport's growing CO<sub>2</sub> emissions jeopardise meeting the EU targets under the Kyoto Protocol.

Since the early 1990s, environmental regulations on emission standards have led to a decrease in emissions of NOx and NMVOCs, but these technological efficiency gains have been partly offset by growing transport volumes and the use of heavier and more powerful cars. Meeting the targets of the European Commission's 1999 proposal for a Directive on national emission ceilings would require further decreases in emissions from the transport sector.

## Integration question 2. Are we getting better at managing transport demand and at improving the modal split?

### Key indicator: Passenger and freight transport demand (EU-15)

Index (1970=100)



### Key message

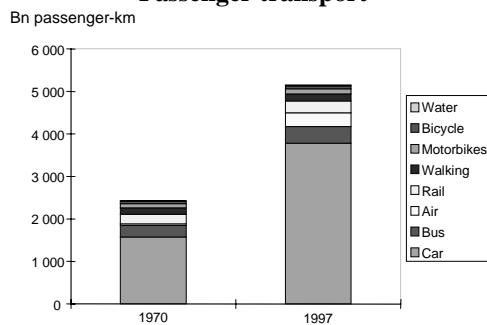
Demand for freight and passenger transport is outstripping both economic and population growth.

Aviation shows the fastest annual growth (7.7% per year), followed by car transport (3.3% per year). Car ownership is increasing.

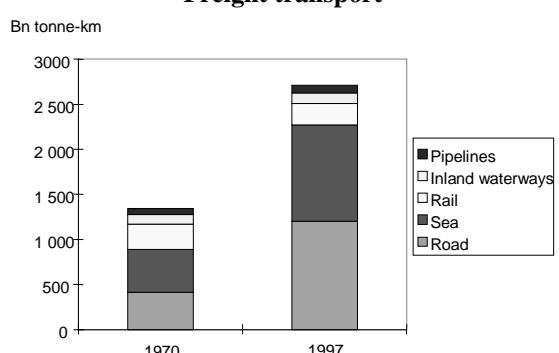
During recent decades, a major modal shift towards road transport has taken place.

### Key indicator: Modal shares of passenger and freight transport demand (EU-15)

#### Passenger transport



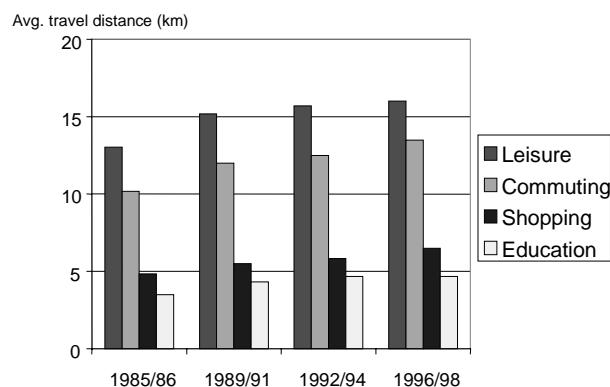
#### Freight transport



Source: Eurostat, DG Transport.

**Integration question 3. Are spatial planning and transport planning becoming better co-ordinated so as to match transport demand to access needs?**

**Key indicator: Average journey lengths by purpose (Great Britain)**



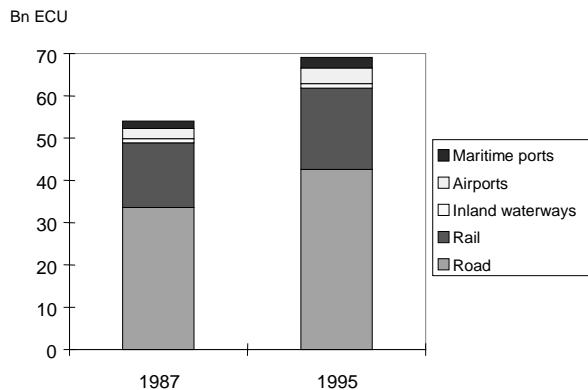
Data from a number of countries indicate that people have to travel increasing distances for basic services such as shopping, work and education.

Access is more and more dependent on car use.

Source: Department of the Environment, Transport and the Regions (1999).

**Integration question 4. Are we improving the use of transport infrastructure capacity and moving towards a better-balanced intermodal transport system?**

**Key indicator: Investments in transport infrastructure**



**Key message**

Distribution of investments favours the development of road infrastructure.

Motorway lengths have increased more than 50% since 1970.

Although rail receives a larger share of total investment than its share of total demand, this has not been enough to counter the decline in supply, quality and reliability (and hence use) of railways in some countries.

In the implementation of the trans-European transport network, the planned road programme (which involves construction of about 12 500 km of new motorways) is well ahead of high-speed rail development.

Source: Eurostat.

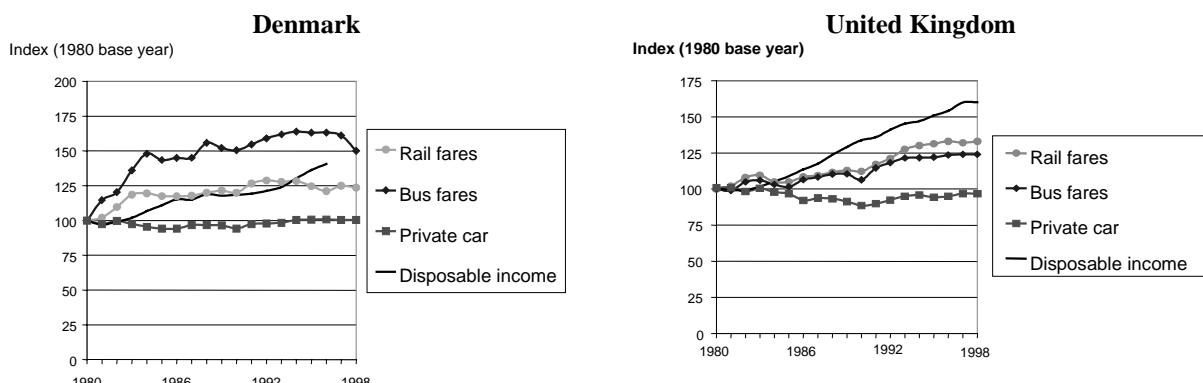
**Integration question 5: Are we moving towards a fairer and more efficient pricing system, which ensures that external costs are minimised and recovered?**

**Key message**

Current pricing systems encourage the use of the private car rather than public transport. Road transport is much cheaper relative to disposable income and public transport than it was 20 years ago.

Less than half the external environmental and accident costs of road and rail transport (tentatively estimated at some 4% of EU GDP) are internalised by the market prices paid for these services. “Getting the prices right” requires full internalisation of environmental costs in market prices, and application of the user- pays principle.

**Key indicator: Real changes in the price of transport**



Source: Statistics Denmark; Eurostat.

Source: Department of the Environment, Transport and the Regions, UK (1999).

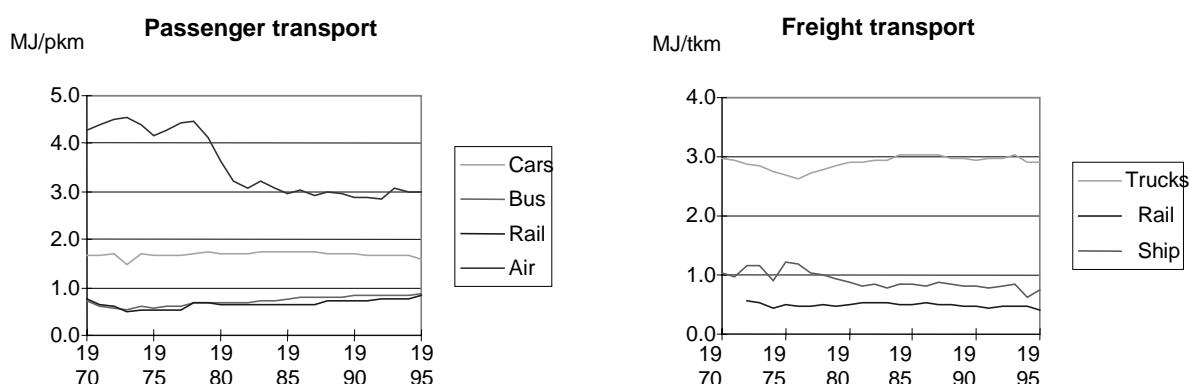
**Integration question 6: How rapidly are improved technologies being implemented and how efficiently are vehicles being used?**

**Key message**

The energy intensity of passenger and freight transport has shown little or no improvement over the past decade.

Technology improvements have made vehicles more fuel-efficient, but the increase in heavier and more powerful vehicles, together with decreasing occupancy rates and low load factors, have offset these gains.

**Key indicator: Energy intensity of passenger and freight transport (8 EU countries)**

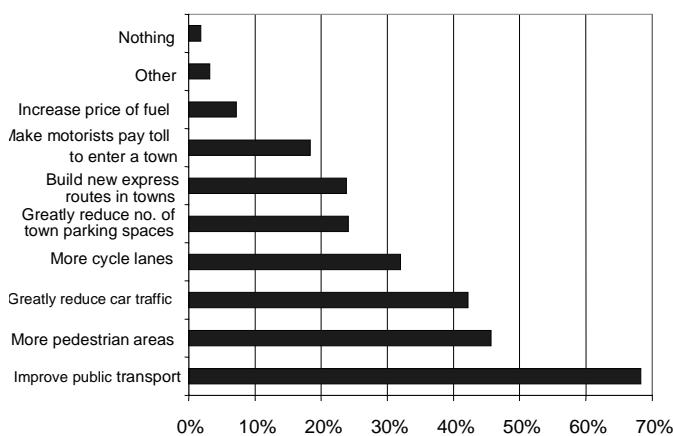


Source: International Energy Studies, Lawrence Berkeley Laboratory, compiled from recognised national sources.

## Integration question 7: How effectively are environmental management and monitoring tools being used to support policy and decision making?

### Key indicator: Public opinion regarding solutions to transport problems

*In your opinion, which one of these measures would make it possible to solve environmental problems linked to traffic in towns most effectively?*



### Key message

Few Member States have as yet developed and implemented an integrated transport and environment strategy.

Improvements in public transport, cycling and walking provisions and car restrictions in certain areas are the solutions most supported by the public.

The use of pricing measures to achieve such improvement is, however, much less acceptable to the public. Furthermore, the link with own behaviour is not always made.

*Note:* Representative sample of 16 000 EU citizens.

*Source:* Eurobarometer, 1999.

## **7. BENCHMARKING EUROPEAN RAILWAYS AN ASSESSMENT OF CURRENT DATA AND RECOMMENDED INDICATORS**

*by*

**Chris Nash and Jeremy Shires  
Institute for Transport Studies, University of Leeds, United Kingdom**

### **Summary**

The performance of the rail sector has long been the cause of much concern, and it is for this reason that a range of institutional and regulatory reforms are being introduced worldwide. This makes benchmarking particularly important as a way of judging the success of alternative policies. It is also crucial for regulators, and indeed for managers and shareholders as well, to know how efficiently the companies they regulate are performing.

Yet benchmarking in the rail sector is not easy. Railways produce many outputs (transport of diverse quality between a variety of origins and destinations at various times of the day/week/year), use many inputs and are subject to severe problems of joint costs and major economies of scale and scope. Moreover, their performance is heavily influenced by the geography of the area in which they operate and by government policies regarding regulation, subsidies, investment and employment. Although a set of key indicators of operating, commercial and financial performance is put forward, analysts are warned to consider carefully the factors that influence each of these indicators.

Data sources are considered next. The key source for international railway comparisons is *International Railway Statistics*, published annually by the International Railways Union (UIC). Even there, however, problems of data comparability exist, and the fragmentation of the rail industry in some countries leads to less complete data.

To illustrate the intuitiveness and also the potential problems associated with the use of partial productivity measures, a number of key indicators for selected countries have been calculated and commented upon.

Finally, more sophisticated benchmarking methods are considered, including measures of total factor productivity and data envelopment analysis. These methods produce single measures of efficiency and allow more systematic statistical testing of hypotheses, but are less readily intelligible than simple partial productivity measures.

It is concluded that there is a need to consider a range of measures to try to understand the causes of differences in efficiency, but that a good understanding of the conditions under which each railway operates is crucial.

## **Introduction**

The rail sector has long been at the centre of policy makers' attention. In many countries, rail has been losing market share and has either required increasing subsidies or has not shown adequate rates of return. This has led to a wide range of policies to improve the situation, including major steps towards vertical separation into infrastructure and train operating companies with increased access for new entrants in Europe and outright privatisation or franchising to the private sector in many parts of the world, including Japan, much of South America, New Zealand and Great Britain.

Correspondingly, there has been strong interest in measuring the performance of rail operators in order to compare it with other economic sectors and to try to detect the influence of different institutional arrangements through comparisons over time or with other railway companies running under alternative arrangements. This process, commonly referred to as benchmarking, takes various forms, *e.g.* measure of partial productivity or of total factor productivity.

National governments and, increasingly, European governments must determine the most effective and efficient form of regulation and ownership (Oum *et al.*, 1999) for the rail industry. Likewise, rail companies must determine the factors that drive costs and productivity, and shareholders must be able to assess how their company is performing. Last but by no means least, regulators need to know whether the costs of the companies they are regulating are reasonable and the extent to which they should seek lower costs through regulatory policy.

The next section considers the general problems of benchmarking in the rail sector. Some key indicators are then presented, along with the difficulties in getting the necessary data. Finally, more sophisticated benchmarking methods are discussed and conclusions are drawn.

### **General problems of benchmarking in the rail sector**

This section examines the general problems encountered when measuring performance and feeding the results into the process of benchmarking railways. Three characteristics of railways make performance measurement particularly complex: multiplicity of outputs; complexity of the production process, including multiplicity of inputs, joint costs and economies of scale; and differences in the operating environment, including geographical factors and government intervention that may prevent purely commercial decision making.

#### ***Multiplicity of outputs***

At its simplest, rail output may be regarded as the transport of passengers or freight. Thus, passenger-kilometres and freight tonne-kilometres are the usual starting point for measuring rail output. Rail managers often add these together to form a measure of output known as traffic units, although it is only appropriate if they cost similar amounts to produce. Otherwise, increasing productivity may simply mean that the railway is moving towards producing more freight traffic and less passenger traffic or *vice versa*. Hence, such a simple measure of output has grave shortcomings.

Multiple outputs are a common feature of transport firms. Strictly, an output needs to be described in terms of the provision of transport of a specific quality from a specific origin to a specific destination at a specific point in time. Therefore, an operator of rail passenger services running trains between ten stations ten times per day and offering two classes of travel is already producing

1 800 different products. A large European railway has literally millions of products on offer. Obviously, it is impossible to provide performance measures which identify each product separately.

This is only really a problem if the different products have significantly different cost characteristics and their traffic is growing or declining at different rates. For instance, if the transport costs for passengers between London and Leeds and London and Manchester are similar, performance measures will not be distorted by regarding them as the same product. On the other hand, failure to identify traffic whose costs are very different is very distorting. For instance, part of the rapid improvement in productivity of British Rail (BR) freight wagons in the 1980s was due to the decline and eventual suppression of movement of single wagon loads in favour of movement of traffic in full trainloads.

In passenger transport, longer-distance, faster-moving traffic and traffic moving in large volumes generally cost less per passenger-kilometre to handle than short-distance traffic or traffic that moves slowly and in small volumes. This is because of the spreading of terminal costs and the economies of operating longer trains. Peaks in demand also lead to poor productivity as they require using a lot of resources for only a small part of the day. There is thus a fundamental distinction between different types of passenger traffic (inter-city, suburban, regional).

Freight traffic is particularly complex because of the lack of a homogenous unit of measurement; at least in passenger transport the unit of measurement is always people. A tonne of freight may cost very different amounts to transport according to the product's density (a single wagon will contain many more tonnes of a dense than of a non-dense product) and its form (bulk solids or liquids can be loaded and unloaded much more simply than manufactured goods, although the latter are easier to handle when containerised). It follows that loaded wagon-kilometres may be a better unit of measurement than tonne-kilometres, and that distinctions may be needed between trainload, wagon-load and container or intermodal traffic. If tonne-kilometres are used, a distinction by commodity is important; for instance a railway with declining coal and rapidly growing intermodal traffic will almost certainly show declining productivity if tonne-kilometres are the measure.

### ***Complexity of the production process***

Second, rail technology is relatively complex. Providing a rail service requires locomotives, passenger coaches or freight wagons (or self-powered vehicles), track, signalling, terminals and a variety of types of staff (train crew, signalling, track and rolling stock maintenance, terminals and administration). While all may ultimately be regarded as forms of labour and capital, the length of life of the assets and government intervention with respect to employment and investment often mean that, at a particular point in time, a railway does not have an optimal configuration of assets and staff. This renders attempts to measure inputs simply as labour and capital difficult, as measures of the value of capital stock will need to allow for excess capacity and inappropriate investment. An alternative is simply to look at physical measures of assets (kilometres of track, numbers of locomotives, carriages and wagons) but this obviously makes no allowance for the quality of the assets.

A related problem is joint costs and economies of scale. For instance, a single track railway may carry both passenger and freight traffic, a passenger train with first and second class passengers and a freight train with various commodities. In this situation, only some costs can be specifically attributed to one form of traffic; the remaining costs are joint. The result is that railways are typically characterised by economies of scope; that is, when a single railway handles a variety of types of traffic, the costs are less than if each product is handled by a different railway. Moreover, most

evidence suggests that railways are subject to economies of traffic density. Putting more traffic on the same route generally reduces unit costs, unless the route is already heavily congested.

The result is that apparent rises in productivity may be caused by diversification into new products or by increased traffic density rather than by improvements in the efficiency with which given tasks are performed.

### ***Operating environment and government intervention***

The operating environment of course exerts a strong influence on railway performance through its impact on the nature of the traffic carried. However, geography has other influences as well: gradient, climate and the complexity of the network are all likely to influence costs.

Government intervention also strongly influences performance. In addition to employment and investment, already mentioned, governments frequently intervene in railways' pricing and output decisions. Performance measures for such railways typically provide information on a mixture of the performance of the management and the institutional setting. For passenger services, it is not uncommon for governments to effectively control the frequency of service on each route, either as part of a formal franchising agreement or as a public service obligation. In this situation, the government arguably becomes the customer, and the railway's output is a certain level of service rather than transport for a number of people. In any event, frequency of service is an important quality attribute. A railway manager wishing to minimise costs might run one very long train per day, but this would not be very attractive to customers. No sensible railway manager provides a frequency of service that minimises costs if more frequent service improves net revenue or benefits. This suggests that, unless a way is devised to adjust passenger and freight tonne-kilometres for quality of service, changing the output unit to train-kilometres rather than passenger- or freight tonne-kilometres might be desirable (it would still be necessary to disaggregate train-kilometres according to their cost characteristics, as it costs much more to shift a 5 000 tonne freight train than a two-car branch line passenger train). Certainly it seems mistaken to regard railways with grossly overloaded trains, as for instance in some developing countries, as performing well despite very inefficient train services.

### **Key benchmarking indicators**

Benchmarking facilitates comparisons between companies and within companies over time. The measures most widely used by both the rail industry and academics are partial productivity measures (PPMs) (Oum *et al.*, 1999). These relate a firm's output to a single input, for example traffic units per train-kilometre (load factors). According to Oum *et al.*, they are popular because they are easy to calculate, are intuitively understood and require limited data.

Table 1 shows what the key indicators should be when benchmarking using PPMs. The limitations of PPMs and their alternatives are discussed below.

As Table 1 shows, the key benchmarking indicators can be broken down into operations, commercial and financial. Some of these indicators were initially outlined in University of Leeds/BRB (1979). The operations indicators are designed to reflect use of key assets – staff, vehicles and infrastructure. Indicator 1.1 is less influenced by government and external factors than other indicators and so is probably the best single estimate of labour productivity. It should be noted, however, that traffic mix and national government employment initiatives may influence this indicator. Traffic mix and geographical factors also influence indicators 1.2 and 1.3.

Table 1. Key benchmarking indicators

Area	Indicators
1. Operations	1.1 Train-km/staff 1.2 Vehicle-km/year (by vehicle type) 1.3 Train-km per track-km.
2. Commercial	2.1 Market share 2.2 Mean train load 2.3 Mean length of haul
3. Financial	3.1 Total cost per train-km 3.2 Receipts per traffic unit 3.3 Revenue/cost

Indicator 2.1 reflects not only management efficiency but also the competitive conditions facing the railway. It is likely that high government subsidy and/or low-fare regulatory regimes create an unrealistic market share scenario. Indicator 2.2 makes it possible to compare mean train load. A high load would appear to indicate an efficient operator, but these figures should be disaggregated by passenger and freight sectors since a heavily loaded freight sector, in a railway dominated by freight, could produce a misleading figure. Also, it is important to recall the comments on service quality above – a low frequency, high load-factor policy is not necessarily commercially or socially optimal. Indicator 2.3 is important for understanding whether or not comparisons are meaningful but is largely determined by geography and government policy rather than by the actions of railway management.

Total cost per train-kilometre (indicator 3.1) is a key indicator for comparing the underlying costs of train operators. However, such figures should be treated with caution given that accounting conventions differ between countries with respect to capital costs. For example, Preston *et al.* (1994) reported that capital costs (historic cost depreciation and interest charges) can vary from 29% (Danish Railways, DSB) to 6% (BR). It is also important to examine the extent to which differences are explained by different factor prices, in particular wage rates.

Indicator 3.2 attempts to exclude operating subsidies by using traffic receipts rather than revenue. However, these figures may still reflect government policy regarding either fare (de)regulation or subsidy levels. Indicator 3.3 (cost recovery) is seen by many commentators as the key comparison indicator, but it should be looked at in light of fare and service obligations imposed by both national and local governments.

With regard to key indicators, it is envisaged that, where possible, figures should be disaggregated, at least at passenger/freight level and ideally further (*e.g.* inter-city services, suburban services), although this is only possible for staff or costs that can be reliably allocated to a sector. Further disaggregation, *e.g.* by type of labour, is also valuable. In addition, it is important to view all these key indicators in light of other indicators and background information. While the next section expands on the more general problems experienced when comparing railway performance, mention should also be of quality indicators, environmental indicators and interoperability indicators.

There is a growing awareness among policy makers, rail passengers and residents of the benefits of a quality rail service that reduces adverse environmental impacts. Key quality indicators include speed, frequency and punctuality measures (trains arriving within X minutes of expected time) and accident measures (by severity). Key environmental indicators should include measures of air and noise pollution per train-kilometre.

## Data problems

### Data availability

As already discussed, the rail industry has a complex structure which leads to a diverse product mix. The effort required to monitor and assess the range of outputs should not be underestimated.

At present, most industry analysts and academics obtain their information on rail inputs and outputs from two key sources: the *International Railway Statistics* collated by the UIC and individual railway accounts. The former publishes very detailed statistics on rail performance across the world. Considerable effort is made to ensure comparability through the use of common definitions, although UIC is, of course, dependent on the quality of data provided by the individual railways. Other sources of information include national transport statistics, such as *Transport Statistics Great Britain* in the United Kingdom, Eurostat and the World Wide Web (WWW) which increasingly contains data from official sources (rail company Web sites) and unofficial sources (enthusiastic individuals). However, none of these sources has the detail of the UIC's publication.

An indication of the comprehensiveness of the UIC data can be found in Table 2. The 1997 UIC publication covered 121 rail companies and infrastructure providers in some 90 countries. The series has appeared since the 1950s, and, in addition, UIC also produces *Supplementary Statistics*. The statistics are published in French, German and English and include detailed footnotes on changes in railway organisation (for example, vertical separation) and accounting changes. Eurostat has a similar publication, which only covers EU countries and offers much less detail.

Table 2. UIC data

Section	Description of the data
11. Lines	Length of lines/track, % of electrified track, % of double track, % of passenger and freight lines.
21. Tractive stock	Fleet strength disaggregated by type of locomotive, railcars, etc.
22. Passenger transport stock	Fleet strength disaggregated by coaches, railcars, etc.
23. Freight transport stock	Fleet strength disaggregated by covered wagons, high-sided wagons and flat wagons.
31. Staff	Disaggregated by operating and traffic staff, traction and rolling stock staff, permanent staff and operations staff.
41. Train movements	Train-km disaggregated by locomotive and railcar types and by passenger and freight trains.
42. Gross hauled tonne-km of trains	Tonne-km disaggregated by locomotive and railcar types and by passenger and freight trains.
43. Rolling stock movements	Train-km disaggregated by locomotives, railcars and wagons.
51. Revenue-earning passenger traffic	Passengers and passenger-km disaggregated by first and second class.
61. Freight traffic	Tonnes carried and tonne-km disaggregated by traffic category.
71. Balance sheet	Fixed assets, assets in circulation and liabilities.
72. Specific costs and revenues	Staff costs, taxes, depreciation, freight traffic receipts, passenger traffic receipts and government subsidy.

Source: UIC (1999).

Other important sources of data can be found in annual reports and in national transport statistics. The former give a very detailed breakdown of financial costs and revenues, and the latter make it possible to calculate some of the operational and commercial indicators outlined in Table 1 at national level.

Increasingly, the World Wide Web supplies academics and rail professionals with moderate amounts of data. Data on the WWW can be classified into two types. First, there are official railway operator Web sites which have been constructed and are maintained by rail operators, e.g. SNCF, SNCB and Hellenic railways. Second, there are sites which have been constructed and are maintained by enthusiasts (e.g. Railways of Norway, <<http://www.ifi.uio.no/~terjek/rail/>>).

The former type of Web site essentially consists of an interactive timetable, a description of the company and some key contact addresses. Some also include their annual report (SNCF) and their key activities. The Hellenic railway site also contains data on rolling stock, length of line and personnel. However, these sites are essentially a marketing tool to promote the rail company, while offering passengers the opportunity to interact with the online timetable. The latter type of Web site occasionally contains useful information but in view of their unofficial nature, they cannot be relied upon for accuracy and consistency.

It is clear that while there are several data sources for benchmarking, the main ones at present are UIC statistics, Eurostat and company annual accounts. However, a major source of concern in the last few years has been the effect on data availability of the separation and privatisation of the European rail industry. This has been a particular problem in the United Kingdom, where the rail industry was transformed from a single company in 1993 to around 30 by 1996. Not only has this made the task of data compilation more complex and arduous, it has in many cases made it impossible, since privatised rail operators are often reluctant to release details of their operations. This is reflected in the 1997 UIC statistics, which contain no data for either Railtrack or ATOC (Association of Train Operating Companies), the umbrella organisation of UK rail passenger operators. In other countries which have followed EC Directive 91/440, the situation is still manageable; in Sweden, for example, the rail industry was only separated into two organisations SJ and BV. However, in Sweden and other countries such as Germany, new rail operators have since entered the market. If more European countries follow, collecting data will become very difficult and make benchmarking an increasingly hazardous task, although in principle the presence of more operators in each country should increase the scope for benchmarking.

A further problem has arisen from the increasing emphasis being placed on European as opposed to national transport flows. Data requirements now encompass transnational flows, and policy makers are finding such data very difficult to obtain. INFOSTAT is a European Commission project that has the task of developing a European wide statistical tool, namely ETIS (European Transport Policy Information System), the aim of which is to fill in the previously mentioned data gaps. According to INFOSTAT (1997) there is:

*“...a lack of data on international transport flows, the impacts of border crossing (TEN) projects, new transport technologies, logistic services, transport chains and environmental impacts of transport. To make matters worse, data availability is decreasing due to the abandonment of border control and customs documents.”*

### ***Problems with available data***

Several difficulties arise when conducting a benchmarking study, most stemming from problems with the data. The major difficulties are outlined below and were briefly touched upon above, for example, the diverse treatment of non-rail activities and the level of activities undertaken by governments as opposed to railways.

#### *Diverse treatment of non-rail activities*

A key problem in benchmarking is the treatment of non-rail activities. Traditionally, railways have owned considerable amounts of land, hotels and other transport companies, such as bus operators and ferries. When comparing rail operators, it is important that their financial performance does not include costs or revenues from these other sectors. Similarly, figures for rail productivity may be adversely affected if bus drivers and mechanics are perceived as rail staff. This problem is recognised by UIC which disaggregates staff into rail services, road services and shipping services, but not every railway returns data in which these are separated out.

#### *Degree of sub-contracting*

A similar problem occurs when railways sub-contract maintenance and engineering work, for example. Not only does this make cross-sectional benchmarking between those that sub-contract and those that do not difficult, it also creates problems when benchmarking over time. For example, the recent improvements in labour productivity in the privatised British rail industry are in part due to the sub-contracting of maintenance and engineering work. It is important when benchmarking to take this into consideration, so that like is compared with like.

#### *Treatment of depreciation and interest*

Differences in accounting conventions throughout the European Union create difficulties for calculating financial benchmark indicators, with different rates of depreciation and interest in individual countries making comparisons difficult. It is recommended that only operating costs be used, although differing levels of investment must also be considered. Moreover, levels and types of investment are heavily influenced by governments, which have often required railways to carry out non-commercial projects.

#### *Data on rail staff/rolling stock/track quality*

For rail staff, data problems exist in terms of disaggregating passenger and freight staff. In addition, staffing is reported in terms of staff numbers rather than staff hours, creating problems when a culture of overtime work has developed, as is the case in certain rail companies.

Similarly, there is very little data available on the quality of rolling stock and track. Thus, some railways might post unrealistic financial results simply by running down their existing rolling stock and track. While such a situation is not sustainable, it could distort benchmarking.

### *Different legal and safety requirements and general government policy*

Legal and safety requirements differ between countries and can have an enormous impact on rail companies' operating costs. For example, Railtrack is legally required to erect fences along its entire track and to install level crossings of differing types where its tracks cross roads. Some other countries have no such legal requirement and therefore no associated costs. Similarly, in countries with hot climates, there is a need for air-conditioned rolling stock (Spain), but this is not an issue in others.

More generally, national governments can greatly influence benchmarking studies. In the past, railways were often used to increase employment and economic activity. Generous subsidies and over-employment can considerably distort benchmark indicators. Even if government subsidies are removed from rail revenues, their influence is still likely to be felt in reduced fares.

### *Interpretation and measurement errors*

A general problem for any data is errors that occur in interpretation and measurement (Oum *et al.*, 1999), for example, of how station staff are allocated between freight and passenger operations. Measurement errors are also common in any data collection exercise and can sometimes lead to erroneous results. It is difficult to correct for such errors, and researchers and analysts need to be aware of such problems when carrying out benchmarking and double-check outlying observations. In addition, data are sometimes simply unavailable and proxies are used.

### *Time series data*

Another problem with benchmarking is the time period covered. A study which examines a single year may not give a true reflection of the situation if certain exceptional costs have been incurred or if a downturn in the economy has resulted in a considerable loss of patronage. The best benchmarking studies are those that examine rail operators over a period of time (Oum *et al.*, 1999) and so reflect longer-term trends in rail performance.

### *Existing benchmarking and actual problems*

This section presents and comments on a number of indicators in Table 1. The examples are taken from a recent benchmarking study carried out as part of an EC Fourth Framework Transport Research Programme called SORT-IT (Strategic Organisation and Regulation in Transport) (Shires, 1998). SORT-IT calculated a number of benchmarking indicators using a data set constructed from UIC sources for 17 European countries for the period 1971-94, although 1994 data have mainly been used, along with a mean figure calculated for the period 1989-94. Indicators were calculated for 11 European countries which reflect the diversity of the European rail industry in terms of network size, traffic mix, geography and government philosophy.

### *Operational indicators*

The indicators in Table 3 reflect operational performance. In terms of labour productivity, the Swedish, Dutch, Spanish, Swiss and British railways appear to enjoy considerably higher productivity than others. Furthermore, judging from the mean figures, all their performances improved during the early 1990s. This also appears to be the case for all railways. However, it should be noted that

Great Britain's rail workforce works considerably more overtime than their European counterparts, and this certainly helps inflates their productivity rates. In addition, trains tend to be shorter and more lightly loaded than those of other European operators.

**Table 3. Labour productivity and track productivity**

Train company	Train-km/staff		Train-km/track-km	
	1994	1989-94 Average	1994	1989-94 Average
Austria	2 170	1 992	23 424	22 161
Belgium	2 355	2 317	26 573	26 608
France	2 747	2 555	14 671	14 342
Germany	2 798	n.a.	21 050	n.a.
Great Britain	3 511	3 329	24 445	25 556
Italy	2 255	1 787	19 514	19 020
Netherlands	4 435	4 388	42 725	42 710
Portugal	2 449	1 925	12 779	11 899
Spain	3 747	3 583	12 189	13 135
Sweden	4 926	4 253	10 051	9 221
Switzerland	3 516	3 264	40 651	40 092

n.a. In this and subsequent tables, pre-1994 data for Germany are not comparable because of reunification and are therefore omitted.

Source: UIC, *International Railway Statistics*.

The track utilisation indicator reflects intense productivity per track-kilometre by both the Dutch and Swiss railways. These indicators reflect the compact nature of both networks and the large amount of through traffic in both countries. In Britain's case, rationalisation of the network after the Beeching report and the tendency for short trains running at high frequency go some way towards explaining the high levels of track use. In contrast, the Swedish, French, Spanish and Portuguese railways have relatively low levels of use, owing to the very long lengths of the Swedish and French networks and the less frequent Spanish and Portuguese rail services.

#### *Commercial indicators*

Commercial indicators are contained in Table 4. Market share is often used to judge management efficiency, and from the figures shown, one might suppose that rail management efficiency is declining throughout Europe. The largest market shares are those of Switzerland and Austria and Britain's is the smallest. However, according to the labour productivity indicator, Britain is substantially ahead of many other operators. It might be argued that it is not surprising that Britain's market share has declined as a result of stiff competition from a deregulated bus and coach industry, (Nash and Preston, 1994) especially given pressures to recover costs (Table 5).

The figures for mean train load in both the passenger and the freight sectors again suggest that Britain's railway industry is inefficient because of its low loads, while, overall, the trend is slightly downwards for all the operators except in Italy, the Netherlands and Switzerland. The UIC data, however, reveals that in Britain and Austria, low loads in the passenger sector dominate the overall mean load. It should be noted that lower loads may also reflect a higher quality of service in terms of a greater frequency of service.

Table 4. Rail's market share and mean train load

Train company	Passenger market share <sup>1</sup> (%)		Freight market share <sup>2</sup> (%)		Traffic units/train-km <sup>3</sup>	
	1994	1989-94	1994	1989-94	1994	1989-94
Austria	n.a.	9.87	42.3	42.9	162	172
Belgium	6.51	7.01	14.4	16.9	163	167
France	7.79	8.66	24.7	25.8	224	234
Germany	7.35	n.a.	23.3	n.a.	150	n.a.
Great Britain	4.45	5.07	8.8	9.18	103	111
Italy	6.49	6.89	10.3	9.1	222	221
Netherlands	8.22	7.57	4.6	4.43	147	136
Portugal	5.56	6.54	n.a.	5.06	196	204
Spain	6.21	7.35	4.9	n.a.	151	158
Sweden	5.95	5.61	n.a.	n.a.	252	264
Switzerland	13.02	13.22	39.3	46.2	165	164

1. Market share for land-based passenger transport excluding subways, from *Transport Statistics GB* and based upon passenger-kilometres.
2. Market share for land based freight transport, from *Transport Statistics GB* and based upon tonne-kilometres.
3. Mean train load taken from UIC, *International Railway Statistics*.

n.a. Data not available. For Germany, pre-1994 data are not comparable because of reunification and are therefore omitted.

Source: UIC, *International Railway Statistics*.

Table 5. Rail charges and cost recovery ratios

Train company	Operating cost/train-km (GBP)		Receipts/traffic units (pence)		Revenue/costs	
	1994	1989-94	1994	1989-94	1994	1989-94
	Mean	Mean	Mean	Mean	Mean	Mean
Austria	14.2	14.8	3.3	3.4	0.38	0.40
Belgium	23.7	20.7	3.1	3.0	0.21	0.24
France	15.7	16.3	3.5	3.5	0.50	0.51
Germany	8.6	n.a.	5.0	n.a.	0.89 <sup>1</sup>	n.a.
Great Britain	17.5	11.2	6.0	6.1	n.a.	0.70
Italy	19.0	26.8	3.8	3.0	0.44	0.26
Netherlands	9.2	8.78	3.4	3.2	0.54	0.50
Portugal	10.4	12.0	1.9	2.1	0.37	0.37
Spain	11.5	12.7	2.8	2.8	0.36	0.35
Sweden	13.2	11.2	2.2	2.3	0.42	0.54
Switzerland	14.0	13.3	3.9	3.9	0.46	0.48

1. This figure suggests that the restructuring of the German railway has led to a change in the definition of its costs and revenues. This makes comparison with other countries very difficult.
- n.a. Data not available. For Germany, pre-1994 data are not comparable because of reunification and are therefore omitted.

Source: UIC, *International Railway Statistics*.

## *Financial indicators*

Total costs per train-kilometre reflect the underlying costs of train operators. Costs appear to have fallen for six of the operators during the early 1990s, reflecting an improvement in cost efficiency (or possibly a reduction in quality). In the case of Belgium and Britain, costs appear to have risen substantially. However, in Britain, this is mainly due to vertical separation and a massive increase in costs via infrastructure charges, *e.g.* the 1993 figure was GBP 8.70 per train-kilometre. This shows the distortions that can be caused by changes in accounting conventions and by exceptional cost items. In all cases, costs and revenues are in real terms and reflect market exchange rates.

The second indicator, receipts/traffic units, excludes operating subsidy but may reflect fare regulation. The figures show that charges have remained more or less constant throughout the early 1990s and that the highest charges were levied by Britain (absence of government control of fares across most of the British network, with the exception of London). The final indicator reflects cost recovery. There appears to have been little change over the period considered (Italy having achieved the greatest improvement) with rates of cost recovery typically 50% or less. Not surprisingly, the British railway industry has achieved the highest mean rate with a combination of relatively low costs and high charges. The inability to calculate a 1994 figure for Britain reflects the difficulties of collecting data from an industry that was vertically separated into around 30 distinct entities, even though still under public ownership, in that year.

This section has attempted to illustrate both the advantages and the potential pitfalls of using partial productivity measures for benchmarking purposes. The next section considers more sophisticated and complex benchmarking methods.

## **Alternative benchmarking measures**

While PPMs are the main type of indicator used for benchmarking, they have been criticised as being too intermediate, in that they fail to produce a single measure of true measure of economic output. Many observers have also noted that increased productivity of one output often comes at the expense of lower productivity of other inputs, which makes comparisons between operators more complex. In an effort to remedy these problems, a number of alternative benchmarking measures have been developed and are outlined below.

### ***Total factor productivity***

Clearly, a measure of performance would be easier to interpret if different outputs and inputs could be added together to provide a single measure of output per unit of input. A traditional way of doing so (*e.g.* Deakin and Seward, 1969) is to use prices as weights for outputs and inputs. However, this is only really appropriate if the relative prices of outputs reflect their relative marginal costs and of inputs their cost elasticities. While the latter may be a reasonable assumption, provided the institutional arrangements are conducive to cost minimisation (by no means always the case), the characteristics of railways – economies of scale and government intervention on price – make the former most unlikely to hold. Empirical estimates of relative marginal costs are therefore needed.

While some econometric work to measure rail cost elasticities dates back to the 1950s, it used functional forms which make strong assumptions about the characteristics of the elasticities being measured (see, for instance, Griliches, 1972). The big breakthrough in rail productivity measurement

had to wait until adequate methods were developed to measure the elasticity of rail costs with a variety of types of output, without prior assumptions as to the form the relationship would take.

The key paper in the development of these methods for rail transport is Caves *et al.* (1980) who used data for US railroads for the period 1951-74 and estimated a multiproduct translog cost function, with tonne-miles, average length of haul, passenger miles and average length of trip as output measures, and labour, way and structures, equipment, fuel and materials as inputs. The cost elasticities from this model were then used in a discrete approximation to the following formula:

$$\frac{\partial \ln g}{\partial T} = \sum_{i=1}^m \frac{\partial \ln g}{\ln Y_i} \frac{d \ln Y_i}{dT} - \sum_{i=1}^n S_i \frac{d \ln X_i}{dT}$$

where

$g$  = total cost

$T$  = time

$Y_i$  = output of type  $I$

$S_i$  = share of costs attributed to input of type  $i$

$X_i$  = input of type  $I$

In other words, the percentage rate of change of costs over time (the measure of total factor productivity) is equal to the sum of the percentage rates of change of the outputs weighted by their cost elasticities, less the percentage rates of change of the inputs weighted by their shares in total cost.

Their results showed that productivity was growing at some 1.5% over this period, whereas more traditional methods gave a much higher figure.

In analytical terms, the paper was a great advance on previous work in the field. However, it still had one major shortcoming. The cost elasticities were estimated from cross-section data pooled for three years. Thus, they reflected the effects of a changing volume of traffic in a context where the route network and assets of the railway were also varying; generally, railways with more traffic also had more route-kilometres. They did not allow for the economies of density which occur when more traffic is loaded onto the same route-kilometres, which is what generally happens when a railway increases its traffic over time. To the extent that railways were gaining traffic over this period, the increase in total factor productivity may still have been overstated.

This phenomenon had already been identified by Keeler (1974), who estimated a model in which kilometres of track were entered explicitly as a variable. Keeler found, as have most subsequent studies, that if track length is adapted to traffic levels to minimise costs, costs rise almost proportionately to traffic levels. However, it is not usually possible to achieve this while retaining network coverage; some track which is not fully utilised has to be retained, because on some routes traffic levels are inadequate. In the presence of this excess capacity, there are substantial economies of traffic density; adding more traffic to the same track does not lead to a proportionate rise in costs. Subsequent studies (*e.g.* Caves *et al.*, 1987) allow for this.

Use of the results of total factor productivity studies for policy purposes has generally taken the form of simple comparisons between railways in different circumstances, either cross-sections or over time. For instance, comparisons of Canadian and US railways (Caves *et al.*, 1981) showed that productivity growth accelerated in Canada after deregulation, exceeding that in the United States, whereas it had previously been slower. Also, a comparison of the two main railways in Canada, Canadian Pacific and Canadian National, the former at the time privately owned and the latter public (Caves *et al.*, 1982), showed no evidence that the performance of the latter was inferior to that of the former. It was therefore concluded that deregulation and the promotion of market competition, rather

than ownership, were the critical factors in determining railways' performance. Of course there was no direct evidence that could be subjected to statistical analysis to show that these differences in performance were due to the institutional arrangements in question rather than to other unmeasured variables.

An alternative, two-stage approach to measuring the impact of the institutional environment on performance, in which this relationship could be tested statistically, has subsequently been developed. In this approach, performance measures are regressed on data representing the operating environment and institutional framework. This method will be considered below, along with the development of approaches that better allow for differences in performance of individual railways.

### ***Data envelopment analysis***

The methods discussed in the previous section rest on an estimation of cost functions, assuming cost-minimising behaviour by all firms. This is not only unlikely given the institutional framework within which most railways operate, it is also inconsistent with using the results in a study that assumes that the performance of individual railways varies. It would be more logical to use a model that allows directly for differences in the performance of individual railways.

Data envelopment analysis is one such approach. It essentially estimates a production possibility frontier and uses the relative distance of firms from that frontier as a performance indicator. In other words, the efficiency of individual firms is measured as a percentage of that of an efficient firm located on the production possibility frontier. A study of 19 railways in Europe and Japan was an early application of this approach to railways (Oum and Yu, 1994); it tested models using passenger kilometres and freight tonne-kilometres and also the alternative of passenger train and freight train kilometres. The results are of great interest.

For 1978, using passenger-kilometres and freight tonne-kilometres as output measures, only one railway, the Japanese National Railways, achieved 100% efficiency. However, using passenger train and freight train kilometres as measures of output, Japanese National Railways slipped to 96% efficiency, while British Railways, Netherlands Railways, Norwegian State Railways and Swedish Railways all achieved 100% efficiency. These railways ranged from 74% to 90% efficiency on the alternative measure of output. The differences are readily explained by comparing the heavily loaded trains of Japan with the much lighter trainloads of the other countries. Which measure is to be taken as the most appropriate? By 1989, Britain, Ireland, Portugal, Japan (1986 data), Sweden and Finland had all become 100% efficient on the passenger-kilometre and freight tonne-kilometre measures of output, but using passenger and freight train kilometres, Portugal slipped to 85% and Finland to 96%, and the Netherlands and Spain increased to 100% from 94% and 77%, respectively.

These efficiencies were then regressed on a range of variables representing the environment in which the railway operated, including traffic density, length of haul, levels of subsidy and degree of managerial autonomy. Where the output measures were passenger-kilometres and freight tonne-kilometres, high passenger train loads were found to increase efficiency. Where the outputs were measured in train kilometres, high passenger and freight train loads and a high proportion of passenger traffic reduced efficiency. In both cases, a high level of electrification increased efficiency, and the two policy variables had statistically significant coefficients, which suggested that lower subsidies and greater managerial autonomy led to higher levels of efficiency.

### ***Cost and production functions and frontier estimation***

An alternative to allowing for differing degrees of efficiency between firms is to estimate cost functions, allowing explicitly for the fact that not all firms will be on the minimum cost frontier. The simplest way to do this is to allow for deterministic differences in costs by introducing a dummy variable for each railway. In this way, Preston (1996) found very high returns to increasing density on low density railways such as those of Ireland, Finland, Norway and Sweden, while the two most densely used rail systems, those of Switzerland and the Netherlands, had negative returns to density. Similarly, small railways, such as those of Ireland, Denmark and the Netherlands, had strongly increasing returns to scale, whereas those of large railways, such as those of France, Germany and Great Britain had negative returns to scale.

The dummy variable shows the divergence between the level of cost the equation would predict for a particular railway and the level which, on average over the period, it has achieved. With the railways of Spain taken as 100%, the most efficient operators were found to be those of Sweden and France, which were respectively 30% and 27% below the costs of Spain. At the other extreme, the costs of the railways of Austria, Belgium and Portugal were respectively 100%, 82% and 65% above those of Spain.

Alternatively, the method of corrected ordinary least squares, in which the frontier is shifted by the amount of the largest negative residual, may be used (Perelman and Pestieau, 1988). An alternative that is increasingly preferred is to allow use of stochastic frontier methods, which allow for the deviation from the frontier to be stochastic (it can obviously still only be in one direction). The first application of this approach to railways appears to be a study by Gathon and Perelman (1992) which estimates a production possibility frontier using panel data for 19 European railways. One strength of approaches that estimate cost or production functions directly is that variables reflecting the environment in which the railway operates may be directly introduced into the model. For instance, the last-mentioned study includes an index of managerial autonomy and found this to be positively related to efficiency.

### **Conclusions**

The previous section outlined a number of alternatives to the commonly used PPMs for benchmarking. Their relative advantages are that they make it possible for policy makers to process different inputs and outputs and produce a single measure of efficiency. The use of frontier measures (stochastic and deterministic), in particular, has made it possible to recognise and measure the sources of inefficiency (Oum *et al.*, 1999).

On the other hand, PPMs are more readily understood and use of a range of measures that can offer valuable evidence as to the sources of variations in efficiency. However, there are general problems that can be said to affect all benchmarking methods. There are difficulties in measuring and interpreting data; in deciding what inputs and outputs to use; in defining the sample size. Other problems include isolating the effects of exogenous variables, such as government influence, geography and climate.

The key lesson to be drawn is that benchmarking has to look at the underlying conditions of the railways. Results should be seen in relation to the environment of the firms being examined. In general, no single benchmark can be applied to all railways; it is necessary to consider what might reasonably be achieved given the circumstances of the railway in question. If possible, several benchmarking methods should be used simultaneously, since each gives its

particular insight and since all share similar data requirements. Perhaps the key issue is to ensure that the quality of the data collected improves rather than deteriorates.

There is a danger that recent developments in the European rail industry will result in less information being collated. This is already a major problem in the United Kingdom. It is not restricted to the rail sector but also encompasses the bus sector. Safeguards should be put in place to ensure that monitoring and data collection do not break down when rail companies are restructured or privatised, *e.g.* by specifying this function in a franchise contract. Emphasis should also be placed on the methods of monitoring and collecting data. Continuing advances in transport telematics and smart-card technology would suggest that more disaggregated data could be collected for considerably less cost than at present. Another issue is the type of monitoring and data collection that is required. The increasing focus on international flows within the EU and on the quality aspect of rail operations means that data collection needs to reflect these two issues.

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## **8. URBAN TRANSPORT BENCHMARKING PROJECTS**

*by*

**Paul Hodson  
DG Transport, European Commission**

Good local and regional transport, with a greater role for public transport, cycling and walking, helps the economy by tackling congestion. It contributes to the European Community's environmental targets, for example, the reduction of emissions of greenhouse gases. It enables those without the use of a car to play their full part in society.

Because of subsidiarity, the Commission's role is to support, not to take the lead. The Commission aims to help practitioners answer two questions:

- What good ideas are being tested elsewhere in Europe?
- How does our own transport system compare, in terms of what it offers citizens?

To answer the first question, the Commission launched last year the European Local Transport Information Service,<sup>1</sup> with more than 300 case studies of good practice.

To allow authorities and operators to answer the second question, the Commission launched, at a conference held in October 1999 in Brussels, the "Citizens' Network Benchmarking Initiative". This exercise builds on a pilot project carried out in 1998-99 in 15 cities.

### **The European Commission's Urban Passenger Transport Pilot Benchmarking Project (1998-99)**

The Commission selected 15 cities and regions (Athens, Bremen, Dresden, Edinburgh, Genoa, Graz, Ile de France, Lisbon, Merseyside, Nantes, Oulu, Prague, Strathclyde, Stuttgart and Terni) from more than 40 that applied to take part in the pilot project.

In the first stage, the cities and regions tested more than 150 questions to see which would give a picture of local passenger transport systems, including public transport and car use, walking and cycling. On that basis, 38 indicators were chosen because they are useful and because most cities and regions can find the data in a reasonably similar form. Annex A gives a picture of some of the good practices that this part of the project has revealed. Annex B is a full list of the indicators. Annex C gives an example from the pilot benchmark project.<sup>2</sup>

In the second stage, the cities formed subgroups and carried out site visits to inspect good European practice in areas where they were keen to improve their own performance.

They studied:

- How to make buses as attractive as trams.
- How to market sustainable forms of transport to car users.
- Integrated public transport information services.
- How to make good strategy decisions in a complex interagency context.

They learnt that people from cities and regions of very different sizes and cultural backgrounds can learn a great deal from looking closely at each other's transport systems.

Several of the cities and regions are already implementing practical changes as a result. For example, the *Syndicat des Transports Parisiens* (Ile de France) is basing the design of a new bus service on lessons learnt from the project.

### Notes

1. [www.eltis.org](http://www.eltis.org), an initiative of the European Commission in partnership with the International Union of Public Transport and a consortium led by the POLIS network of local and regional authorities.
2. Further details of the pilot project are available on the European Local Transport Information Service ([www.eltis.org/benchmarking](http://www.eltis.org/benchmarking)).

**ANNEX A**  
**Results from the urban passenger transport benchmarking pilot project**  
**European Commission, 1999**

**Athens** is notable for its high proportion of low-floor public transport vehicles (approximately 50% of the fleet) and its high share of trips by public transport (32%).

**Bremen** is also notable for its high proportion of low-floor public transport vehicles (approximately 85% of the fleet) as well as for its high share of trips by bicycle (19%).

**Dresden** is notable for its priority for public transport at road junctions (45 priority junctions for every 100 000 residents), as well as its real-time service information on the Internet.

**Edinburgh** is notable for the high proportion of road-based public transport routes on reserved lanes (5.5%) and for the rate at which cycling is growing (approximately 10% a year).

**Genoa**, too, is notable for its high proportion of road-based public transport on reserved lanes (more than 8.8%), as well as for the density of its public transport network (10.3 stops per square kilometre).

**Graz**, with its surrounding district, is notable for its high proportion of low-floor public transport vehicles (40%) and for its high share of trips by bicycle (10%).

The **Ile de France** is notable for its park and ride facilities (970 spaces for every 100 000 residents) and for the high share of trips on foot (34%).

**Lisbon** is also notable for its park and ride facilities (477 spaces for every 100 000 residents), as well as for the attractiveness of its public transport fares compared with the cost of operating a car (the normal fare for a month's public transport use would buy only 22 litres of fuel).

**Merseyside** is notable for the density of its public transport network (9.6 stops per square kilometre) and for its large number of taxis (438 for every 100 000 inhabitants).

**Nantes** is notable for the fact that the market share of alternatives to individual motorised transport is growing (by 0.9% per year) and for the proportion of public transport routes on reserved lanes (4.6%).

**Oulu** is notable for its high share of cycling trips (28%) and for its cycle paths (290 km for every 100 000 residents).

**Prague** is notable for its high share of public transport trips (46%) and for the public money it devotes to providing information about public transport services (EUR 48 000 a year for every 100 000 residents).

**Strathclyde** is notable for its high share of trips on foot (33% of all trips) and for its low car ownership (306 cars for every 100 000 inhabitants in the region as a whole, and only 246 for every 100 000 inhabitants in the city of Glasgow at the centre of the region).

**Stuttgart** is notable for the fact that the market share of alternatives to individual motorised transport is growing (by 1.3% a year), and for the high number of road junctions where public transport has priority (46 junctions per 100 000 residents).

**Terni** is notable for a high number of off-vehicle sales points for public transport tickets (278 per 100 000 residents), and for using the Internet to provide real-time information about public transport services.

**ANNEX B**  
**Urban passenger transport benchmarking pilot project:**  
**Key performance indicators**

Full results are available on [www.eltis.org/benchmarking](http://www.eltis.org/benchmarking).

A.1 Basic facts about the cities/regions (area, population, population density).

A.2 How people travel today, and how this compares with ten years ago.

A.3 Are alternatives to individual motorised transport winning new users?

B.1 Level of use of public transport, today and ten years ago.

B.2 The availability of public transport:

- Public transport stops/stations (of all types) per km<sup>2</sup>.
- Kilometres of public transport route (of all types) per km<sup>2</sup>.
- Off-vehicle sales points for public transport tickets per 100 000 inhabitants.
- Proportion of low-floor vehicles in the public transport fleet.
- Park and ride spaces (for cars and powered two wheelers) per 100 000 inhabitants.
- Taxis per 100 000 inhabitants.

B.3 Priority for public transport:

- Proportion of road-based public transport routes that run along reserved lanes.
- Road junctions (per 100 000 inhabitants) equipped with devices which give priority to public transport vehicles.
- The average “commercial speed” of buses in the city centre during peak traffic periods (km/hour).

B.4 Provision of information services for users of public transport:

- Annual expenditure on information services for public transport users (EUR 1 000 per 100 000 inhabitants).
- Provision of a public transport information service on the Internet or Minitel.

B.5 Attractiveness of public transport:

- Normal cost (EUR) for a month of public transport use.
- How many litres of petrol could be bought for the same amount as the cost of a month of public transport use (at the normal fare)?
- Is it possible to use a single ticket for a single journey which involves changing from one type of public transport to another?
- Is there a service guarantee, charter or compensation scheme for passengers using public transport?

C.1 Levels of walking, today and ten years ago.

C.2 Provision of pedestrian areas: 1 000 square metres of pedestrianised area per 100 000 inhabitants.

D.1 Levels of cycling, today and ten years ago.

D.2 Provision of cycle lanes/cycle parking:

- Kilometres of cycle path per 100 000 inhabitants.
- Public bicycle parking spaces per 100 000 inhabitants.

E.1 Levels of car use, today and ten years ago.

E.2 Levels of car ownership:

- Cars per 1 000 inhabitants.
- Level of car ownership in the city/region, compared with the national average.
- Relationship between car ownership and car use.

E.3 Cost of parking and motor fuel:

- Typical cost of an hour's parking in the city centre on a weekday (in EUR).
- Average price (in EUR) of a litre of petrol.

F.1 Levels of use of powered two wheelers, today and ten years ago.

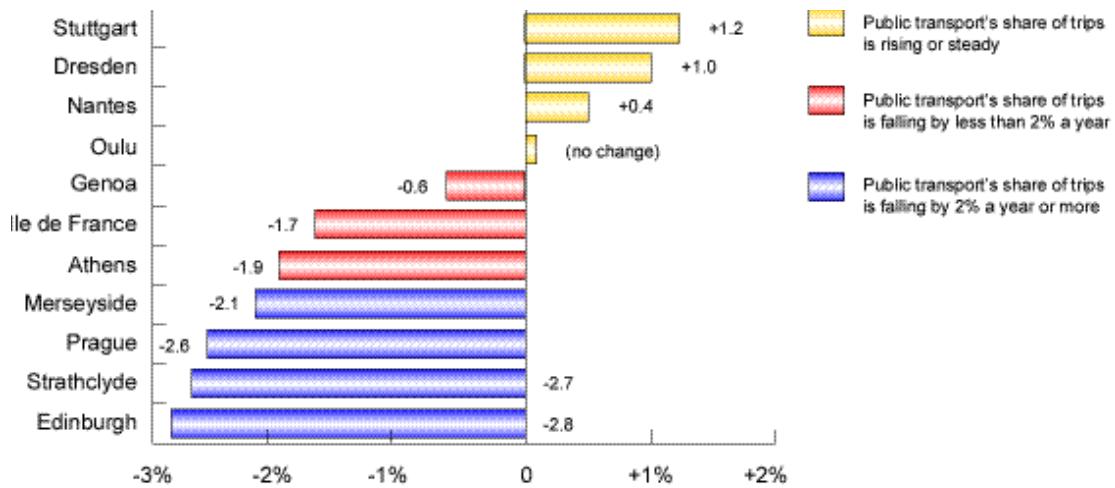
F.2 Level of ownership of powered two wheelers.

G.1 Trends in air quality: have the number of days per year when fixed air pollution thresholds are breached been decreasing?

**ANNEX C**  
**Example from the brochure**  
**“The Citizens Network Benchmarking Initiative”**  
**Results of the pilot project ([www.eltis.org](http://www.eltis.org))**

B.1.2. Question: What is the average annual rate of change (%), over the past ten years (approximately), in public transport's share of trips made?

**Approximate average annual rate of change over the past ten years**



Source: European Commission.

**Comment:** In some cities/regions in the pilot project, public transport's share of trips is rising or remains steady, while in others the share is falling. These trends highlight the challenge cities/regions face in addressing the problem of developing more sustainable transport networks, with less reliance on private cars.

In the cities of Stuttgart and Dresden (both in Germany) and Nantes (France), public transport's share of trips has been growing over the past ten years. In Oulu (Finland), the share of trips by public transport has remained steady over this period.



## **9. BENCHMARKING IN URBAN TRANSPORT**

*by*

**Anne Grünkorn and Cleo Pouw  
POLIS, Brussels**

### **Introduction**

POLIS is an association of European cities and regions working together on transport and environmental problems using innovative transport solutions. The network, founded in 1989, currently represents over 55 cities and regions in 17 European countries, including central and eastern Europe.

POLIS has been active in increasing the awareness and expertise of cities and regions in creating truly integrated and sustainable transport systems. It acts as a strong lobbying voice for European cities and regions by setting priorities for transport actions and strategies at European level and by investigating incentives for co-operation and funding mechanisms. Through regular conferences, workshops, newsletters and Web resources, POLIS members discuss common local transport issues, exchange experience, remain informed about EU policies, programmes and opportunities and build partnerships.

POLIS members are active in EU research and programmes, testing innovative transport policies, systems and technologies at local level. POLIS currently co-ordinates a number of projects within the European Commission DG VII Transport Research Programme:

- CARISMA-Transport (concerted action involving Member States' representatives and five EU/CEEC cities for practical input) for improving interconnections between local and long-distance transport networks (passenger transport).
- European Local Transport Information Service (ELTIS), an on-line interactive database and discussion forum on European local transport activities ([www.eltis.org](http://www.eltis.org)).

POLIS also leads two projects within the European Commission DG XIII Telematics Applications Programmes on transport and the environment:

- CARISMA-Telematics for investigating issues arising from the experience of cities and regions using intelligent transport systems (best practice examples), looking at near-market transport and telematics application and services. Main output: advice and guidance notes on implementation of transport telematics for cities and regions.

- CAPE for increasing the awareness and knowledge of telematics-based solutions to transport and environmental problems, primarily in central and eastern European local authorities, compilation of country reports (accession countries) and best practice case studies ([www.rec.org/REC/Programs/Telematics/CAPE](http://www.rec.org/REC/Programs/Telematics/CAPE)).

## **Urban transport system**

Demand for travel is increasing in most European cities and regions. The cost of congestion is estimated at EUR 200 billion a year in the EU. Moreover, the transport sector represents 30% of the EU's final energy consumption.

Transport and mobility are moving to the top of citizens' agendas everywhere. Commuters, tourists and businesses alike are calling for more effective transport measures that will allow for greater mobility and accessibility while being safer and more environmentally friendly. At the same time, the essential role of transport in assuring urban and regional development and economic welfare is a common issue among EU decision makers.

Good accessibility is of utmost importance for the social and economic vitality of cities and regions. It is also crucial for the optimal functioning of economic centres, main ports as well as cities. Therefore, accessibility is crucial for the prosperity of cities and regions and thus has a direct impact on the Trans-European Transport Network. The quality of logistics is also determining the climate for choosing a place of business and consequently affects employment. Currently, accessibility of economic centres, industrial zones and living areas is hindered by congestion, especially in the main road network. The challenge for cities and regions is to use scarce infrastructure optimally. Moreover, use of public transport and bicycles, especially in city areas, should be encouraged.

Transportation and land use are inextricably related. Mobility has affected where people live and work as well as where society has chosen to locate other human activities. Accessibility has become a key issue in the private sector's land-use decisions and affects a city's or region's employment situation. The greater the accessibility, the more valuable the land.

In the coming years, European competitiveness is likely to reflect cities' and regions' efforts in this area. The EU could give further support to appropriate efforts. A realistic solution to short-term congestion problems would be better use of the traffic and transport network. Therefore, policies should also aim at influencing the modal split and particularly at reducing the increase in automobile use. It is necessary to influence the choice of transport means. This requires cities and regions to have an integrated set of mutually reinforcing measures and projects. The concrete implementation and realisation of such projects is the most important challenge for cities and regions. Cities and regions in Europe should encourage practical experiments which make use of international benchmarking and collaboration between cities and regions. Therefore, cities and regions throughout Europe work with POLIS in order to work together on traffic management and related topics at European scale.

## **Key performance indicators for urban transport**

Travel results from the need to move from place to place to carry out the myriad activities that people engage in. In addition, the more people are concentrated in an area, the greater the demands they place on the transport system. Knowledge of the number of inhabitants, their location and their basic characteristics all help define transport needs. Consequently, cities and regions can profit from urban transport benchmarking initiatives to improve their existing urban transport situation (Table 1).

Table 1. Potential key performance indicators for urban transport

Key performance indicator	Description
Population density and geographical situation	<p>Localised growth within the urban area may contribute to significant traffic congestion.</p> <p>Low-density single-family residential areas will stimulate/support a local bus service, for example, while high-density multi-family residential developments can support many forms of mass transport.</p>
Employment density/industrial and service sector balance/growth sectors	<p>Increased employment will stimulate an increase in vehicle-kilometres of travel and requires the support of appropriate transport services.</p>
FAR (floor area ratio and regional land use (low or high density)	<p>FAR is the ratio of the gross amount of buildings divided by the total land area on which the buildings are sited. It is very significant in terms of number of trips generated, handling of parking, and type of transport service to be provided. The higher the FAR, the more trips are generated and the more public transport services are needed.</p>
Legal framework of EU Member States	
Travel characteristics	<p>Urban travel has a wide variety of characteristics, which include the trip's purpose, timing and length and the mode used. The trip generation indicator measures the number of trips generated for a particular land use. Trip generation is usually described in terms of "person trip generation" and "vehicle trip generation". It is always given for a specific period of time, generally a single hour (normally a peak hour) or a full day. Household size, vehicle ownership, and other socio-economic factors, such as household income, all affect trip generation.</p> <p><i>Trip's purpose.</i> The purpose of the trip influences the mode used, the time at which it is made, its length and other attributes. As household size increases (increase in the number of adults) there is a higher number of vehicle trips per household. Vehicle occupancy varies by the trip's purpose. Work trips tend to have low occupancies, owing to the high percentage of drive-alone commuter trips. Non-work trips include shopping, school, personal business and recreational trips.</p>

	<p><i>Temporal characteristics.</i> Trips vary according to day of the week and the month or season of the year.</p> <p><i>Trip lengths.</i> Shopping trips tend to be the shortest in length and of the same order of magnitude as school trips. Vacation trips tend to be longest.</p> <p><i>Modal trends.</i> This measures number and length of trips made by different modes of transport. It covers not only private vehicles and public transport but also movement of pedestrians and bikeways.</p>
Goods movement	<p>The vitality of an urban community is dependent upon the efficient movement of goods. Trucks are the primary transport mode for goods movement in urban areas. Trucks have a significant impact on the operation and safety of urban highways, both within the traffic stream and as they load and unload.</p> <p><i>Trip generation.</i> This involves information on the number of trips generated by truck.</p> <p><i>Trip frequency and length.</i> This indicates the number of trips per truck per day as well as the average length of the trip.</p>
Infrastructure (provision/quality/accessibility/costs/ownership)	Road/rail/inland water/port/airport
Safety	
Environment	

## Conclusion

Since 1989, POLIS member cities and regions have shared their expertise to find and implement new solutions to common transport problems and create integrated and sustainable transport systems. Many POLIS members are interested in being active participants in EU-funded R&D projects in the field of urban transport benchmarking. Some member cities have already undertaken benchmarking in the public transport sector but are looking to develop a more intermodal approach. In particular, the role and use of telematics services in all modes (freight and passenger), along with their impact, need to be included.

## **10. PUBLIC TRANSPORT**

*by*

**William Robert Clarke  
Consultant, London Transport/London Underground, United Kingdom**

### **Overview**

This paper describes how a number of the world's major metros and some smaller, but very significant, have worked together since 1994 to formulate a common set of data concerning their activities. Using a process based on case studies that relies on self-assessment and bilateral/multilateral discussion, they have identified best practices and are continuing to add value by increasing customer satisfaction and the size of the market.

These major groupings of metros function in two groups or "clubs": COMET and NOVA. Each of these has a maximum of ten members. They are separated by a "glass wall" so as to ensure appropriate commercial confidentiality. Both clubs are aided by staff of the Railway Technology Strategy Centre, Imperial College, University of London.

The practical operation of the clubs has shown that:

- They must have similar objectives, cultures, problems and expectations.
- Time and effort are needed to establish key performance indicators (KPIs) that are comprehensive, accurate and produce good comparative data.
- Successful implementation is essential and depends on good analysis of specific practices (best practice), sharp focus and continuing commitment.

This has given very positive results, for example:

- A study of station stop times (dwell times) was adopted as a model and has led to improvements in a number of cases. In New York, a programme derived from the study "Step Aside Speed your Ride" produced a 4.5% capacity increase on one of the busiest lines with a prospect of a 17% increase in the long term. This required no additional investment.
- Exchanges of views on the life of engineering assets on metro systems has enabled London Underground to undertake a full review and more accurately assess investment requirements for the long term.
- Reviews of safety practices has enabled BVG in Berlin to re-examine and reformulate its station safety planning and operation for both the short and the long term.

Over a five-year period, all the members have become convinced of the value of such studies and their ability to:

- Lead to real (not theoretical) improvement.
- Involve managers and staff in a self-assessment and continuous improvement process.
- Focus better on the market and increased customer satisfaction.

In brief, the work has contributed to the process of creating sustainable mobility.

## Description of problem

### *Introduction*

In the European Union, the performance of public transport varies widely, in both financial and operational terms, as a result of a series of political, economic, historical and social factors and decisions.

While operators and authorities of all types have worked together on subjects of mutual interest for many years, most results have been discounted in light of local factors and have thus failed to have a real impact on performance and overall service to customers or satisfaction for stakeholders.

Companies have used “financial benchmarking” for a long time. The best examples of the use of this technique are those of stock market analysts who assess a wide range of companies against a series of measured performance parameters. In this way, company reports are used to create “benchmarks” which can work in favour of good performers and damage the prospects of others.

### *Benchmarking – a comprehensive process*

In many companies and enterprises, the use of benchmarking techniques to compare performance, nationally and internationally as well as within their sector and against other sectors, has become well established in recent years. For example, major national railways – largely owned by their respective governments – have reported their performance to national regulatory agencies as well as to their own trade body, the *Union internationale des chemins de fer* (UIC).

Urban passenger transport has been slower to apply benchmarking principles. In many cases, this was due to principles of deficit financing and thus “more of the same”, as opposed to “company plans” whose targets for continuous improvement eventually lead to benefits in terms of gross margins. In addition, particularly in road passenger transport, operators have been very concerned that lack of data confidentiality would reduce their competitiveness.

Despite this, Germany’s *Verband Deutscher Verkehrsunternehmen* (VDV), for example, has been able to collect and publish performance data. Outside Europe, Section 15 (FARES Reporting System) in the United States requires all public transport operators (bus and rail) to report annually on a range of measures of efficiency and effectiveness. Further examples are discussed below.

## ***Why is public transport an important area for benchmarking?***

The European Commission's 1996 Green Paper identified passenger transport and, in particular, public passenger transport as a sector growing at an annual rate of 3.2% while the average annual growth of GDP in real terms has been 2.4%.

Growth has largely occurred in private transport where 75% of total kilometres are by private car, 10% by bicycle, walking, air and other means, and the remaining 15% by conventional public passenger transport.

It is clear that reinforcement and improvement of public transport facilities and services are vital for transferring demand from the private car to public transport. To this end, the quality and quantity of public transport must be raised. Operators and transport authorities are realising that they will have to adopt new practices and techniques to remain competitive and succeed. As a result, they are increasingly willing to adopt benchmarking as a way towards successful "continuous improvement programmes" and identification of best practice techniques, as examples from the rapid transit or metro sector of the railway industry show.

### **The development of benchmarking in the urban rail sector**

Urban rail operations in the metro and rapid transit sector, particularly in the major conurbations and cities worldwide, play a vital and increasing role in business and the economy in the areas they serve. Around 26 billion passenger journeys are made on such systems annually, and the economic and environmental effects of even a one-day cessation of service on the systems can be extremely serious.

The Russian Federation leads in rapid transit ridership, followed by Japan. The Moscow system carries over 3.2 billion passengers a year. New York – the only US city in the top ten – carries some 1.2 billion riders and is fifth in total ridership.

The International Union of Public Transport (UITP) through its Metropolitan Railways Committee has for many years maintained a strong interest in the comparative performance of its members. In 1983, its Finance and Commerce Sub-committee was asked to carry out surveys every two to three years to assess comparative performance and the productivity of networks. Within the limitations of the data available, this was considered a very effective and useful process.

The desire of metro operators to go beyond productivity comparisons to benchmarking was limited as there are generally few major operators in any one country. Such potentially insular groups were seen to be of little benefit. However, in 1994, five of the world's largest urban metros came together to form a benchmarking group with the aim of assessing the value to be gained from exchanging data and reviewing and identifying best practice. A mutual exercise using facilitators was considered more beneficial than using consultants, who were viewed as expensive. In addition, the metros wished to control the process or the direction of the studies. The initial group formed in 1994 consisted of: RATP (Paris), MTRC (Hong Kong), LUL (London), NYCTA (New York), BVG (Berlin).

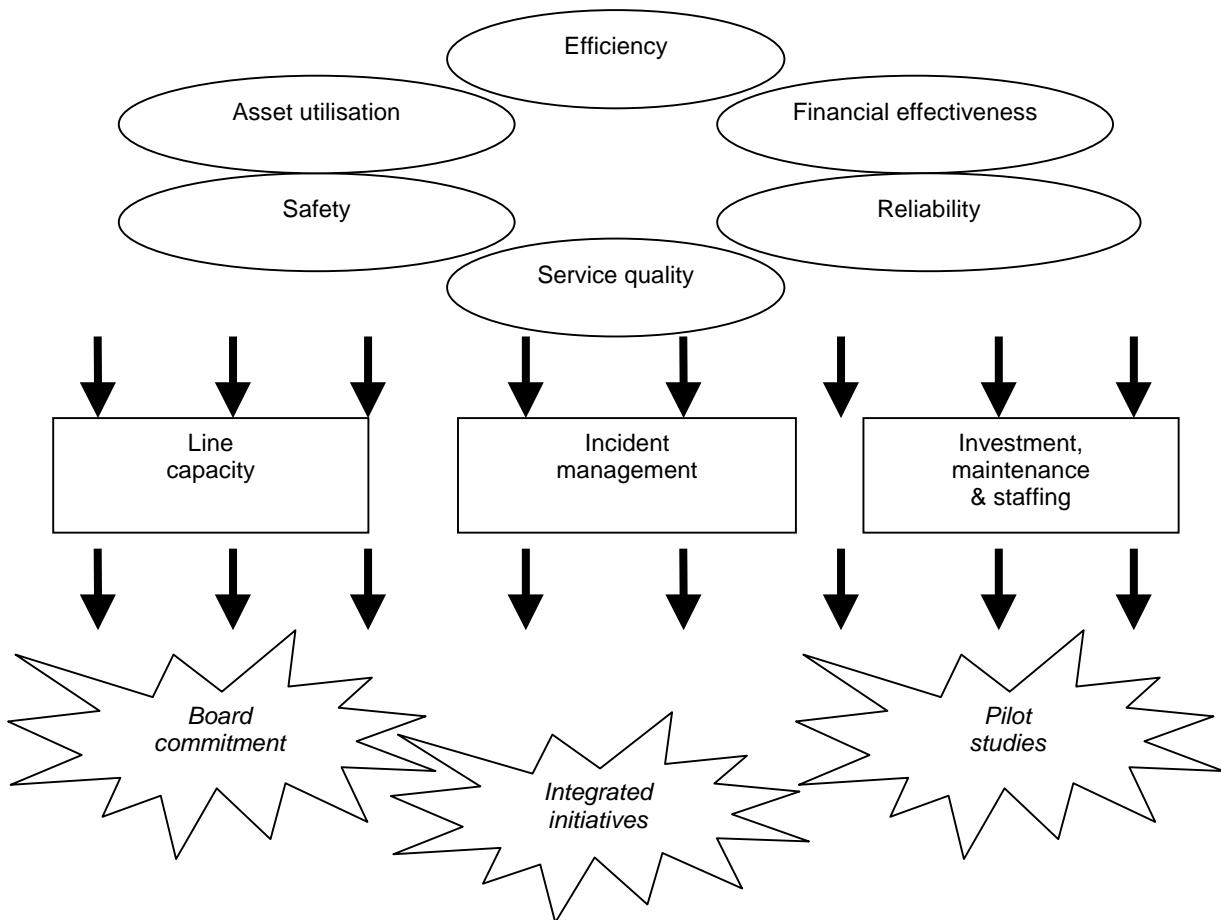
In due course this group became COMET. Its development, results, techniques and subsequent growth are described in the following section.

## Practical aspects of key performance indicators in the COMET and NOVA groups

In connection with studies undertaken by the COMET and NOVA groups, the following objectives were established:

- To provide each operator with insight through selected performance indicators.
- To allow direct comparison of performance between similar organisations.
- To facilitate analysis leading to improved performance through the identification of best practice.
- To encourage a culture of self-assessment, realistic analysis and continuous improvement within the operators' organisations so as to increase competitiveness and effectiveness.

These objectives were supplemented by identification of actions that can lead to a superior performance. These can be summarised as:



At their initial meetings, the members of the two clubs debated the issues raised by the need to control costs and programmes. COMET appointed the Railway Technology Strategy Centre, part of the University of London's Centre for Transport Studies, to run the venture under the control of the participants, rather than as a predetermined programme. A similar decision was taken by NOVA in 1997.

Each group has a chairman from one of the participating metros, a post which revolves on an annual basis. For 1999, COMET is chaired by London Underground (LUL) and NOVA by Singapore Mass Rail Transit Ltd. (SMRT). The chairman, in consultation with other participants, directs the facilitators towards areas offering the greatest benefits or which appear to be current “hot topics”.

COMET and NOVA participants are located on four continents:

<b>COMET</b>	<b>NOVA</b>
Berlin	Glasgow
Hong Kong – MTRC	Hong Kong – KCRC
London	Lisbon
Mexico City	Madrid
Moscow	Newcastle
New York	Oslo
Paris	Singapore
Sao Paulo	
Tokyo	

For both groups the first tasks carried out were to design and agree on a grouping of essential and appropriate KPIs.

In doing so, members recognised that not all performance indicators are “key” to the work of a given operator and, further, that monitoring of any KPI would necessarily lead to an improvement of that indicator. It was therefore essential when selecting KPIs to identify and evaluate the critical success factors applicable to each member.

Out of this process, a balanced and comprehensive set of indicators was developed. A balanced approach requires, for example, avoiding concentration on social benefits or employee satisfaction without taking into account the impact on cost and the public purse. Private-sector firms, instead, have on occasion emphasised short-term shareholder benefits to the detriment of the workforce or the community at large. There must also be a balance between short- and long-term development and investment to ensure what is known as a “balanced scorecard”.

In the COMET and NOVA programmes, it was decided to concentrate on the KPIs that could contribute rapidly to improvement of company performance and provide useful international comparisons between metros with very different histories. Therefore, some KPIs were excluded: employee satisfaction, customer satisfaction and development of new lines and services.

The performance areas and associated critical success factors adopted are described in Table 1. Clear communication and a balance between an all-round view and management focus is crucial in using performance indicators in a continuous improvement programme.

**Table 1. Performance areas and associated critical factors**

Performance area	Typical associated critical success factor
1	Financial performance The railway should be self-sustaining financially (ideally meeting both its operating costs and investment needs from its commercial income).
2	Efficiency or productivity All resources should be used as productively as possible, especially those that take up the highest percentage of the total cost chain.
3	Asset utilisation All assets should be used to their full productive capacity, but capacity should, as far as possible, be adequate to fulfil customer demand.
4a	Reliability (operator view) The service should operate as designed, with the minimum number of disruptions due to incidents due either to equipment failure or human factors.
4b	Service (customer view) The metro should provide the most reliable journey time of all travel modes within the urban area, especially at peak hours, at relatively high speed and with an acceptable travelling environment for most city workers.
5	Safety The metro should be known to be the safest travel mode for passengers and provide a safe environment for those working on the system and the public.

The groups decided that numbers should be carefully controlled to avoid dissipating management effort and resources by establishing too many targets. COMET and NOVA currently have 17 primary indicators (indicated by an upper-case letter in the list below) and 16 secondary indicators (indicated by a lower-case letter in the list below). The primary indicators are designed to be of use to senior managers and the 16 secondary indicators are used by middle management and functional specialists. Each member has its own priority indicators for which it has specific improvement targets. The 33 KPIs in use are:

### **Background**

- B1 Network size and passenger volumes
- B2 Operated capacity km and passenger journeys
- B3 Car km and network route km

### **Asset utilisation**

- A1 Capacity km/route km
- A2 Passenger km/capacity km
- a3 Passenger journeys/station
- a4 Proportion of cars used in peak hours

### **Reliability/service quality**

- R1 Revenue operating car km between incidents
- R2 Car hours between incidents
- R3 Car hours/hour train delay
- r2 Revenue car operating hours between incidents
- r4 Car operating hours/total hours train delay
- r5 Total passenger hours delay/passenger journeys
- r6 Trains on time/total trains

### **Efficiency**

- E1 Passenger journeys/total staff + contractor hours
- E2 Revenue car km/total staff + contractor hours
- e3 Revenue capacity km/total staff + contractor hours
- e4 Number of scheduled trains/year/.driver

### **Financial**

- F1 Total commercial revenue/operating cost
- F2 Total cost/revenue car operating km
- F3 Service operations cost & staff hours/car km
- F4 Maintenance cost & staff hours/car km
- F5 Administrative cost & staff hours/car km
- F6 Investment cost/revenue car operating km
- f7 Total cost/passenger journey
- f8 Operations cost/passenger journey
- f9 Fare revenue/passenger journey
- f10 Average operating cost/station

### **Safety**

- S1 Total fatalities/total passenger journeys
- s2 Suicides/total passenger journeys
- s3 Medical conditions/total passenger journeys
- s4 Illegal activity/total passenger journeys
- s5 Accidents/total passenger journeys

These KPIs also meet the following criteria:

- Provide a comprehensive view of the key areas and their results.
- Be internally consistent, as should be the underlying assumption and definition.
- Be externally relevant, comparing “like with like”.
- Be statistically reliable, with tolerances consistent and appropriate.
- Be from recognisable data sources which can be interrogated.
- Support cause and effect analysis and maximise use of continuous improvement programmes.
- Support critical success factors and monitor real improvement in business objectives.
- Support pursuit of best practice, identifying current best practice and the direction in which it is likely to go.

Operations, maintenance and administration costs are also affected by the complexity of the system, the different technologies in use and the different types of vehicle.

The greater number of variables recognised lead to increased cost volumes and a lesser ability to manage the learning curve and to have appropriate multi-skilled operatives.

Further adjustment is needed with respect to each city's relative costs. The value of the standard currency is very different in the countries of COMET and NOVA members. The ECU has a greater value in Mexico City than in Madrid or Berlin. Fares and costs are determined by local price levels almost without reference to international exchange rate fluctuations. The normal purchasing parity adjustments present a number of logical difficulties in that the basket of goods is not based on the different costs of the metro or on the customers' cost of living. One method is to divide the unit cost or ticket price by the average wage rate. This is an acceptable proxy in all countries covered by COMET and NOVA except Sao Paulo (Brazil) and Mexico City (Mexico).

In summary, the work by COMET and NOVA in connection with data collection and analysis has shown that:

- The individual systems and their environment must be fully understood.
- Background data must provide a context for the KPIs.
- Consistent definitions must be developed and understood.
- Appropriate adjustment factors must be devised to make international comparisons valid.
- The database values must be maintained over a period of time.
- Data which are not comprehensive can still be valuable in the process.

### **Practical aspects of case studies and best practice in the COMET and NOVA groups**

Establishment and analysis of the data and the KPIs is an important process and has encouraged members to identify and discuss items of interest which can then be developed into a series of bilateral or multilateral case studies. Operations, maintenance, engineering and administration are areas that have been identified for study in all organisations. In each case, the group has reached consensus on the priority of subjects for study. The scope of the study is developed by the facilitators and forwarded to the administrators who wish to participate.

Both at information gathering, review and implementation stages, it is presumed that local managers and staff undertake a self-assessment. However, at every stage, local participants can request, on site or electronically, consultation and discussion with the facilitators.

At the conclusion of the study period (which is normally limited to six months), the group receives reports on the case studies and draws conclusions. Then, the individual undertakings decide what to do to implement study conclusions or best practice.

To date, the case study experience has been interesting and has stimulated excellent in-house work in many of member undertakings. So far, case studies have covered: line capacity, investment effectiveness, maintenance methods, levels and balance between investment and maintenance levels, safety management systems, customer service and satisfaction, incident management, reliability, station management, organisation techniques, escalator investment and maintenance and application of new technology.

Each case study has resulted in a best practice document, but there have also been important gains in day-to-day performance in a number of undertakings that have brought benefits to customers and staff alike. The best examples are:

- Reduction in station stop time (dwell time) in New York and London, based on work in Hong Kong (China) and Tokyo.
- Improvement in availability of rolling stock fleets in Berlin, Mexico City and Lisbon, based on work done in Hong Kong (China) (MTRC and KCRC).
- Replacement programmes for equipment on a condition basis as opposed to a time or kilometrage basis in several undertakings, based on work by ConRail in the United States.
- Application of line-management-based organisation in several operators based on work done in London between 1988 and 1991.
- Purchasing and contracting systems to improve “value for money” principles. “Cross-fertilised” work from several undertakings has benefited the whole group, with savings of substantial sums of money.

The case study and best practice work has been supplemented by useful discussion and debate with:

- Other railways, both suburban, freight and long distance operators.
- Airlines, particularly the commuter/business high frequency operators.
- Information technology companies to understand technology and leverage factors that can affect public transport companies.
- Automotive companies to assess the development of a sector with which passenger rail transport must compete.

The COMET and NOVA groups have a policy of disseminating information gained from their work among the rapid transit and metro community. The undertakings do not individually or as a group release data relating to their operations, but they are prepared to release analytical and informative data and comparisons without identifying individual undertakings. Such exchanges of data have been made:

- Between metros (including specialised contacts between engineers and operating experts).
- Within metros, both top-down and bottom-up to encourage participation and self-assessment by managers and staff at all levels.
- To facilitate the creation of Web sites on the Internet.
- To create a compendium of best practices which can be used to access primary information and obtain contact points for details.

## Conclusions

The work programmes of COMET and NOVA indicate that performance measurement and assessment is a necessity for metros. Moreover, both data comparison and case studies have shown that benchmarking has been of great value. All concerned have been unanimous in wishing to make the process implementation-orientated and lead to better value for money for customers and stakeholders.

Beyond the effect on metros themselves, there is a potential for substantial improvements in knowledge of product requirements by global equipment suppliers. In the railway equipment market, products are becoming more global so as to:

- Ensure that products reflect economies of scale and experience worldwide.
- Encourage metros to improve their procurement processes and to increase value for money.
- Facilitate co-operation among metros in their relations and negotiations with suppliers, particularly for rolling stock and escalators.

The benchmarking process of COMET and NOVA has made clear that it must not be a theoretical process and must provide a practical output. The process requires a sharp focus on results that can be implemented in each undertaking and provides insights into processes which can add value to the work of managers and other staff. The process has raised a number of key points:

- Excellent insight has been gained into the process of establishing best practice.
- Information flows among participants have increased in volume and understanding has improved.
- The vital focus on the implementation and change processes has been sharpened.
- Participants need to adopt an industry-wide stance.
- The process can supplement and support discussion and interface with global suppliers.
- Collaboration has improved the focus on increasing the market through increased customer satisfaction.

## **11. BENCHMARKING OF PORTS POSSIBILITIES FOR INCREASED EFFICIENCY OF PORTS**

*by*

**Carsten Friedrichsen  
PLS Consult, Århus, Denmark**

The project “Benchmarking of ports: possibilities for increased efficiency of ports” was carried out on behalf of the Danish Transport Council by a project team comprising PLS Consult A/S, LGC-Consult ApS, Kollberg & Co., and RAMBØLL, with PLS Consult as project manager.

The project was followed by representatives from the Danish Transport Council, the Ministry of Transport, the Association of Danish Ports, the Danish Shipowners Association, the Danish Shipowners Association of 1895, the General Workers Union in Denmark, the Danish Environmental Protection Agency, and the ports of Copenhagen, Århus, and Aalborg.

### **Purpose and methodology of the project**

The purpose of the project was to “analyse factors that seem to determine the usage of the ports (attractiveness) and their efficiency”. The possibilities for increasing the ports’ efficiency were assessed and recommendations for doing so were made. Issues addressed by the project were:

- Why should ports increase efficiency? Is there a reason, and is there anything to compete for?
- Which factors influence users’ choice of port?
- Are there real differences between the efficiency of the different ports and is there a relationship between efficiency and market position?
- Do differences between the ports reflect a possibility for increasing their efficiency?
- What characterises “best practice”?
- What are the key challenges in relation to increasing the efficiency of ports? What recommendations can help achieve this goal?

In this context, efficiency is regarded in terms of time and price or, more explicitly, external efficiency in relation to the port’s users. In some cases, the port’s internal efficiency or “internal performance” was assessed. Internal efficiency covers aspects such as financial standing, capacity utilisation, etc.

## **Methodology**

The project was carried out by benchmarking eight Danish ports. Benchmarking can be described as a method of analysis whereby factors and parameters pertaining to good practice and success within a given sector are compared. The project did not aim to identify the “best port in Denmark”.

The main activities in the project were:

- A largely quantitative comparison of the ports in Copenhagen, Århus, Aalborg, Randers, Køge, Nyborg, Vejle, and Svendborg.
- Case studies on the ports of Sundsvall and Helsingborg (Sweden).
- Qualitative analysis of the ports involved to seek possible explanations for differences in efficiency and to form the basis for a description of the characteristics of “best practice” ports.

## **Arguments for increasing the efficiency of ports**

In a number of cases, the ports are perceived as bottlenecks in the transport chain in terms of costs and logistics. This is one reason for focusing on ports’ efficiency. Furthermore, there are good arguments for strengthening ports’ efficiency and competitiveness when looking at their future market potential, which is generally related to:

- Competition between the ports on existing cargo volumes.
- Competition to secure the greatest share of the general increase in transport volumes.
- The competitiveness of ports and maritime transport as compared to other transport modes.

Even though a major part of the current cargo turnover in ports is determined by structural aspects such as localisation of buyers’ production facilities, it seems that around 10-20% of current short-term volume can be shifted among the ports. For Danish ports, this represents a cargo turnover of 15 million tonnes and an attractive potential for the most successful ports.

On an aggregate basis, cargo volumes in Danish ports are growing, although growth has been greater for other transport modes. Based on a simple forecast of cargo turnover in the ports, volume will have increased by 10 million tonnes in five years. Which ports will secure a share of this growth will depend on their competitiveness and efficiency.

Finally, several sources have proposed moving more cargo volume from land-based to maritime transport owing to the greater efficiency and lower costs of maritime transport. However, on the basis of previous studies, it would appear that the potential for strengthening maritime transport in relation to other modes is limited to approximately 0.5 million tonnes. From the perspective of ports, this is much less interesting than competition among ports and possibilities for greater integration of transport modes.

## **Factors determining users' choice of port**

Interviews have revealed the factors which determine transport buyers' choice of port and the requirements for an efficient port. The most important criteria are, on the one hand, the ports' location, infrastructure and technical equipment and, on the other, the port's total perceived efficiency.

Total perceived efficiency is a combination of several factors, with special weight placed on price and transportation time. Other important factors are quality and service levels and flexibility in cargo handling. For price, time and service, human resources are an important issue; therefore, the ports' contractual aspects play an important role. Also, ports' efficiency is heavily influenced by the availability of technical equipment and co-operation between transport users and the port's key stakeholders. Therefore, the most attractive ports are those perceived as well-functioning systems, efficient and flexible. As a result, good and bad past experience should not be underestimated as a parameter determining users' choice of port.

## **Benchmarking Danish ports' efficiency and attractiveness**

One component of quantitative benchmarking involves a comparison of the ports' external efficiency in relation to their market development and their efficiency in terms of time and price. This component was analysed to assess whether there was a potential for increasing the port's efficiency through greater dissemination of best practice. Furthermore, an analysis of the relation between the ports' efficiency and market position was carried out. Finally, the ports' internal efficiency was compared and covered aspects such as financial standing and capacity utilisation.

## **Efficiency of Danish ports compared to other European ports**

Although the quantitative comparison only covered Danish ports, interviews indicate that Danish ports are considered relatively cheap, efficient and flexible compared to other European ports. This does not preclude the possibility of Danish ports increasing efficiency or learning from other European ports.

## **The ports' market development**

Ports' market share, measured in cargo volumes and number of calls, is a good basis for measuring their attractiveness. It is not possible to identify a clear trend in market development, owing to relatively significant annual fluctuations. Yet certain patterns indicate structural development and increased specialisation among ports. The smaller ports' attractiveness typically lies in specialisation in certain types of cargo (even though larger ports may also specialise). Moreover, larger ports have grown in certain areas.

There is a fair degree of correlation between ports' efficiency in terms of time and price and the market development of different cargo and vessel types.

## The ports' efficiency measured in terms of time

Individual ports differ significantly in terms of the amount of cargo that can be handled per vessel-hour. In other words, they differ in terms of the time required to handle one vessel. Part of the explanation is differences in the handling equipment available in the ports, as some ports benefit from economies of scale. But technical equipment is far from the only explanation of the differences in efficiency.

Individual ports' efficiency, measured in terms of time for comparable vessel and cargo types, generally fluctuates by +/- 25-30% around average levels. This general variation is calculated as a weighted average, giving due consideration to absolute shares of cargo volumes for different types of vessel and cargo (Table 1).

**Table 1. Fluctuations in ports' efficiency for selected types of cargo and vessel**  
Based on completed registrations

Cargo	Fluctuations in relation to average efficiency for different vessel types (tonnes handled per port hour)			
	< 2 000 GT	2 000-10 000 GT	> 10 000 GT	All calls
Container goods	-	+/- 26%	-	+/- 24%
Limestone / cement	+/- 47 to 33%	-	-	+/- 67 to 56%
Grain	+/- 85 to 48%	-	+/- 5%	+/- 80 to 61%
Foodstuffs	+/- 55 to 31%	-	-	+/- 98 to 48%

*Note:* Fluctuations were not calculated for vessel types where records were limited. The category "all calls" includes registrations for vessel types not illustrated.

*Source:* Actual records of approximately 320 calls in participating ports.

On the basis of completed records, it can be concluded that the larger ports have some degree of economies of scale. Efficiency also increases with vessel size, as seems natural. The larger ports' efficiency advantages are not unambiguous, as economies of scale decrease for smaller vessels. There are also several examples of more efficient smaller and medium-sized ports for some types of cargo and vessel. Finally, the largest relative fluctuations are seen in the smaller vessel category (less than 2 000 GT).

## Ports' efficiency measured in cargo-dependent costs (cargo fees and stevedoring)

Since the comparison is based on figures recorded before the implementation of the new legislation for commercial ports, there are only minor variations in ports' cargo fees. There are however significant differences in the levels of stevedoring fees, a major part of total shipping costs. For shorter distances, stevedoring fees are much higher than direct shipping costs (time charter) and account for approximately 75% of total maritime transport costs (excluding feeder transport on land).

Based on cargo fees and stevedoring, ports' efficiency fluctuates by approximately +/- 20-25% around the average level (Table 2). As the table shows, the price variation is smallest for container goods and largest for bulk goods such as rocks, sand and gravel. The data on which the table is based also show that relatively high cargo fees are offset by low stevedoring costs and *vice versa*.

**Table 2. Fluctuations in ports' price efficiency measured in cargo-dependent costs**

Cargo type	Fluctuations from average levels for cargo-dependent costs (sum of cargo fees and stevedoring)
Container goods	+/- 5-7%
Grain	+/- 19%
Limestone	+/- 25%
Coal, etc.	+/- 27-28%
Foodstuffs	+/- 32-23 %
Rocks, sand, gravel	+/- 51-42%

Source: Registration of actual transport assignments in participating ports.

Furthermore, some smaller and medium-sized ports are most competitive in terms of price. The smaller ports appear to be cheaper for the category “grain”, while the larger ports are more competitive for the category “foodstuffs”.

#### **Ports' efficiency measured in vessel-related costs (tonnage, clearing, piloting, towing, etc.)**

Differences in piloting obligations and clearing fees are the main reasons for the relatively large differences in vessel-related fees in ports. Aggregate vessel-related fees fluctuate by approximately +/- 20-25% around average levels. The difference between the cheapest and most expensive port of call is greatest for the smallest vessels [under 1 500 gross registered tonnes GRT)] (Table 3). When measured in actual costs, differences of DKK 2-4 per GRT are quite significant.

**Table 3. Fluctuations in ports' price efficiency measured in vessel-dependent costs**

Vessel size	Differences in DKK per GRT between the cheapest and most expensive port
Under 1 500 GT	Ca. DKK. 4 per GRT
1 500 – 10 000 GT	Ca. DKK. 3 per GRT
Over 10 000 GT	Ca. DKK 2 per GRT

Source: Registration of actual payments from transport assignments in participating ports.

#### **The relationship between efficiency and market position**

There is no perfect relationship between ports' efficiency and their market position, but there are some overall patterns. In over half the cases where a port strengthened its market share for a certain type of cargo, there are indications of price competitiveness on cargo-related costs (sum of cargo fees and stevedoring). Ports with high efficiency (measured in terms of cargo volumes handled per unit of time) also have increasing market shares.

There is also a strong relation between business priorities and initiatives in the individual port and the port's market development. Finally, there are ports that are not very competitive but which have strengthened their market position through a high degree of flexibility which is evident in flexible contractual agreements and a high degree of service in several elements of the service chain.

## Potential for strengthening ports' role in transport

There is thus a significant potential for increased efficiency if best practice is implemented in individual ports. Average efficiency fluctuations of +/- 25-30% in terms of time and +/- 20-25% in terms of price seem to underline this fact.

An assessment of the potential for reducing total costs in maritime transport was carried out on the basis of average variations and an assessment of cost allocation in two cases of maritime transport. It was completed solely on the basis of reductions in time usage and costs of ports and indicates that greater implementation of best practice in ports could yield a 10% reduction in time used and a 15% reduction in costs for maritime transport. It therefore seems not only relevant but also realistic to aim for greater efficiency in the Danish port system.

## The ports' internal efficiency: internal performance

A comparison of factors such as ports' finances, profitability, financial strength and capacity utilisation is less interesting from the perspective of an external user, but these are nevertheless important elements in the ports' long-term development potential.

The comparison shows that the ports involved differ significantly with regard to business and finances and thus have also generated different economic results. The ports' rates of return fluctuate between 2% and 10%, and their financial strength between 20% and 95%. It has furthermore been shown that it is more profitable to carry out real estate administration and fund management than transport activities. Finally, the analysis shows that there are relatively large fluctuations in registered levels of capacity utilisation in terms of quays, cranes and other port equipment. The capacity utilisation of quays fluctuates between 6% and 34%.

## Characteristics of the most efficient ports: best practice

It was not the purpose of the benchmarking to determine the "best port" or to point out the characteristics of the ideal port. It was possible, however, based on comparison and individual analyses, to point out some important characteristics of best practice in port operations.

Four of the participating ports performed significantly better in certain areas of comparison and have therefore been chosen as the actual best practice ports. But it should not be concluded that the other ports are inefficient. Had the focus been on other cargo types and port activities, the picture might have been different.

The ports that form the background for the description of best practice were chosen on the basis of the following elements:

- The interviewed customers' perception of the port.
- Market development measured in market share.
- Efficiency, measured in terms of time for different types of cargo and vessel.
- Efficiency, measured in cargo- and vessel-dependent costs.

Except for a requirement for positive net results and positive net capital, the ports' finances were not used as a criterion.

Furthermore, ports were only compared where relevant. It should therefore not be concluded that larger ports operating with all cargo types are necessarily the best. Best practice is a relative term and an expression of the aggregate assessment of the ports' ability to use their market and operational options as efficiently as possible. Thus, there are small, medium-sized and large best practice ports. The characteristics of best practice ports can be roughly categorised under:

- The port's structurally determined situation.
- The port's business orientation.
- The port's technical condition and logistic aspects.
- The port's finances and contractual aspects.

### **Best practice in relation to the ports' structurally determined situation**

A geographically central location and the presence of large consignors or consignees in the region are important factors in the port's market development. Such ports, however, are not necessarily the most efficient and attractive.

Best-practice ports have been able to utilise their structurally dependent advantages to attract a relatively large volume of cargo within certain areas. Furthermore, they have been able to achieve financial and technical economies of scale within these areas. Less centrally located best practice ports have been able to achieve economies of scale through successful specialisation.

Another important characteristic of best practice ports is to have invested in modern handling equipment in areas where it was feasible to achieve high capacity use of the equipment rapidly.

A third and important characteristic of the most successful ports is a number of loyal users and stakeholders who, through their investments and through dialogue with the port, reinforce this loyalty. Furthermore, these ports have a strong tradition of co-operation, constructive dialogue, and co-ordination of activities and initiatives, etc.

### **Best practice in relation to the port's business orientation**

The study shows great differences in ports' business strategy, attitude towards own efficiency, customer perception, and organisation and control.

Best practice ports seem to see transport and the terminal role as their primary business and give this top priority in terms of investment decisions.

Second, these ports see themselves as service organisations and exhibit a high degree of consciousness of competitive factors and prerequisites for their own success. The ports have also, to a relatively large extent, considered which problems and weaknesses are "there to stay" and should therefore not influence the other decisions of the port.

Third, best practice ports have shown courage and pro-active behaviour in terms of investment and formulation of visionary but well-founded goals in dialogue with users. These ports also listen to users but are not afraid to make demands on them. Negotiation and dialogue take place on the initiative both of the port and users.

Fourth, the more successful ports take well-co-ordinated market initiatives, where the port's management, in co-operation with key stakeholders, has been able to promote interest in using the port for selected types of cargo and activities. Moreover, external (first-time) users can obtain a total proposal for a given service via a limited number of contacts in the port. In other words, the port functions as one system.

Fifth, best practice ports have a relatively high degree of focus on own efficiency and attempt to quantify this. This is apparent in the high degree of detail in the port's registrations and collection of experiences. The use of the term "relatively high degree" indicates that most ports could strengthen their efforts in this field and learn from port case studies in Sweden.

Sixth, the most efficient ports are characterised by real but not destructive competition between businesses on the port. This competition can be illustrated by the existence of several stevedoring companies which supply the same service and/or the possibility for users to supply these services themselves.

Seventh, best practice ports are characterised by a small organisation or a big and strong organisation with well-defined responsibilities but a high degree of insight and horizontal co-ordination between the individual functions of the port's administration. This is very important, since big organisations can be unwieldy and inflexible.

Finally, the division of responsibilities between the port's operational management and the "port committee" is important. What seems most sensible is for the port committee to act as a board of directors and set targets but also show confidence in the operational management. Next best seems to be a situation where the port committee is neutral and is therefore neither part of the team nor an opponent in terms of the port's development potential.

### **Best practice in relation to the ports' technical facilities and logistical aspects**

The study shows that technical equipment is important but not the key efficiency factor. Two of the four best practice ports are highly ranked in terms of technical equipment.

In relation to best practice ports, it should be noted that there is a sufficient supply of equipment with varied capacity, so that it is possible to use the correct equipment for the tasks at hand.

Second, it is characteristic that the port owns most of the equipment or that the key port players co-operate on its use. Both situations result in a relatively high degree of capacity utilisation and limit the degree of sub-optimal use of own (and at times wrong) equipment for a given task.

Third, concrete bottlenecks in transport buyers' shipping capabilities or the port's physical facilities seem less frequent in ports that did well in the comparison. Factors that are considered important in this respect are availability of loading and holding areas near the quay, good traffic conditions, a relatively good integration of transport modes, and, last but not least, the cargo recipient's sufficient capacity (*e.g.* trucks).

### **Best practice in relation to the ports' finances and contractual aspects**

Ports' price and investment policy and contractual relations between employers and employees can generate substantial fluctuations in a port's price and efficiency competitiveness. Generally, these are areas that can be improved.

However, the best practice ports in this area share some common factors. One is that they deliberately use pricing policy to create competitive advantages for selected cargo and vessel types. It is of utmost importance that ports have built-in incentives for users to use the port as much as possible. Furthermore, it is important to co-ordinate pricing policy with other actors in the port's service organisation, so that a price reduction in one area is not offset by an increase in another area of the transport chain.

In terms of contractual relations, best practice ports have two characteristics. One is the presence of flexible contractual relations with no professional borders and a tradition of borrowing human resources in peak periods. Such a system can be founded on silent acceptance or a mutual willingness among employers and employees to solve problems as they occur. The other is the presence of a combination of permanently employed staff in key areas and a smaller number of temporarily employed workers. The relatively high share of permanently employed staff generates good continuity in operations and forms the basis for investments in education and development.

### **Key challenges, recommendations and perspectives for increasing the efficiency of the ports' role in the transport chain**

The key challenges and recommendations described below are based on the notion that it is possible to increase the efficiency of ports' transport operations. The study shows that there are significant differences among participating ports and that greater use of best practice could result in relatively big improvements in terms of time and cost efficiency, even though Danish ports are considered efficient. Furthermore, a number of factors have been identified which seem to characterise the most efficient ports and underline the fact that ports can change and improve their role in transport operations. In this respect, there seem to be four key challenges:

- Exploitation of the possibilities for competition or co-operation between and in the ports.
- A sharpened business focus and better co-operation with users.
- A reorientation of the port's finances and control to focus on the ports' role in transport.
- Making the port system flexible and well co-ordinated.

Recommendations related to these challenges are outlined below.

## **Recommendation 1**

In terms of the possibilities of competition or co-operation between and in ports it is recommended:

- That further liberalisation of port laws should be addressed at political level both in relation to a tightening of port requirements in some areas and greater liberty in others.
- That in their long-term development plans ports should consider possible advantages of strategic alliances with other ports and a more formal co-operation with other port actors.
- That financially troubled ports in particular do not preclude total or partial privatisation as a possible option.
- That the ports view competition among their businesses as a way to increase efficiency.

## **Recommendation 2**

In relation to ports' business focus it is recommended:

- That ports move away from an administrative orientation to a more service- and market-oriented business strategy which could be based on service management principles.
- That ports actively take the initiative and participate in a dialogue with users both in formal and informal forums.
- That ports actively use goals and measurement of performance, efficiency and customer satisfaction.
- That ports, through recruitment and training policies, seek to raise qualifications in the commercial area.

## **Recommendation 3**

In relation to the ports' finances and control it is recommended:

- That ports separate, in their financial records and administrative procedures, port-related and non-port-related activities and divide them into as many business areas as possible.
- That ports, using activity-based costing principles, create a basis for a more detailed and deliberate price policy.
- That ports take a more business-oriented approach to the division of responsibilities for political and operational management of the ports.

## **Recommendation 4**

In relation to co-ordination and flexibility in ports it is recommended:

- That ports undertake to co-ordinate market initiatives to a higher degree
- That ports focus on areas where day-to-day co-ordination among actors can be strengthened and systematised.
- That ports identify the actual importance of contractual problems locally and resolve them on the basis of more recent principles.

## **12. BENCHMARKING AIR FREIGHT SERVICES AN EASC CASE STUDY INTO DEVELOPING KEY PERFORMANCE INDICATORS**

*by*

**Chris Welsh**

**Secretary General, European Shippers' Council/European Air Shippers' Council, Brussels**

The European Shippers' Council/European Air Shippers' Council represent the interests of European industry as users of freight transport services in all modes of transport: deep sea shipping, inland waterways, road, rail and air transport. The 15 national member organisations represent all branches of industry and commerce, which in turn represent companies that transport the majority of cargo shipped within Europe as well as overseas.

The EASC was established in 1986 specifically to represent the interests of air cargo shippers as customers of transport providers carrying air freight. In this capacity, EASC promotes air cargo user interests across a broad spectrum of issues including policy, commercial and technical matters.

### **Benchmarking air freight services: the background**

#### ***The problem***

Unreliability and lack of predictability of air cargo services cause serious problems for regular air freight shippers who depend on air cargo as their main or preferred mode of transport. Air transport users who depend on air cargo services are typically shippers with complex or sophisticated supply chains. They are heavily reliant on just-in-time logistics/deliveries, work with low inventory and need tightly controlled information flows and co-ordinated and close partnerships with all those involved in the air cargo supply chain. Logistics performance is the source of considerable competitive edge for air freight shippers. Benchmarking the performance of air cargo logistics is therefore of crucial importance to the success of European air cargo shippers in the wider global economy.

In 1995, the EASC published "Airfreight 2000 and beyond: a shippers' white paper on air cargo", which drew attention to:

- The poor performance of the air cargo product and its lack of reliability.
- The need to achieve step changes in the level of carriers' performance to improve the performance and predictability of the air cargo supply chain.
- The implementation of common industry measurement standards so that shippers and carriers could benchmark and improve levels of service to the end user/customer.

- The establishment of shipper, forwarder and carrier forums to change relationships within the air cargo industry.
- The joint development of industry standards by all players in the supply of air cargo (shipper, freight forwarder and airline) to improve the overall performance of the air freight logistics chain.

### **The establishment of air cargo industry forums**

Forums which are customer-driven, *i.e.* shipper-driven, and aim to seek industry solutions to perceived or real problems with the freight services:

- UKAFF (UK Airfreight Forum), established November 1996.
- FACE (Forum For Air Cargo in Europe), established March 1996.

### **Methodology to develop key performance indicators (KPIs) in the air cargo industry**

#### ***Step One: developing the KPIs***

- Map out the supply chain.
- Identify the problem areas.
- Develop standard measurements of performance.
- Suggest standards of performance.
- Identify best practices.

#### ***Step Two: agreeing the approach for developing KPIs (UKAFF)***

- Part one: proposed standard measures of performance and targets.
- Part two: proposed best practices which help facilitate measurement and enhance performance.

#### ***Step Three: trials 1 February-1 April 1998***

- Over 1 000 consignments.
- Import and export consignments (United Kingdom only)
- Those taking part were: **forwarders**: Air Express International, MSAS, Wilson UK, BAX Global; **Airlines**: Air Canada, Lufthansa, American Airlines, Cathay Pacific; **their customers, such as** Glaxo-Wellcome, ICI Zeneca, Hewlett-Packard.

#### ***Step Four: the results***

- Results all stood up to the tests.
- Variance in ability to collect necessary data.
- Manual collation and reporting burdensome.
- Formats for reporting measures varied.

### **Step Five: conclusions**

- Anyone can “sign up” to apply the measures
- Ideally, collation and reporting should be automated.
- Reporting of results.

### **Step Six: making the KPIs work**

- Developing generic KPIs: the role of FACE.
- Promulgation: getting the message across.
- Gaining international acceptance: Shippers’ Global Tripartite, further worldwide trials.
- “Signing up”.
- Implementation problems/help.

### **Lessons learnt: the way forward and approach to developing KPIs**

- The shipper’s approach to KPIs.
- The benefits of the approach.
- Making it work.

### **Defining KPIs**

- Defining an approach.
- The players.
- Focus of interest.
- KPIs: individual modes.
- KPIs: individual corridors.

### **Usefulness of KPIs**

- Tactical management tools.
- Measuring and comparing performance of assets/equipment/staff.
- Good for transport operations: compare trucks/equipment/staff/depots/countries.

### **KPIs: micro and macro use**

- Internal managers are micro users of KPIs.
- Operators/carriers, shippers and government are macro users.

### **Three types of performance focus**

- Assets/resources: of major interest to operators.
- Supply chain service levels: of key interest of shippers.
- Infrastructure performance: of most interest to governments/European Commission.
  
- Traditional KPIs = asset performance.
- Supply chain managers want service performance.
- Governments need to extend interest to supply chain service performance.

## **Shippers' approach: proven track record**

- EASC airfreight KPIs.
- Other initiatives: road, rail, maritime deep sea, maritime short sea and infrastructure.

## **Service-level focus led ESC/EASC/shippers to develop:**

- Generic KPIs which are:
  - Translated for each mode.
  - Include performance of relevant infrastructure.

## **Generic service KPIs**

- Four key elements: time, consignment care, compliance, corporate efficiency.
- Applies to all modes: road, deep sea, short sea, rail, air, intermodal, infrastructure.

## **Four key stages in methodology**

- Formulation.
- Dissemination.
- Implementation.
- Benchmarking.

## **Modal KPIs: biggest challenges for implementation**

They must be:

- Cost-effective.
- Capable of being carried out.
- Realistic.
- Meaningful to decision makers.

## **Defining KPIs**

- Defining an approach.
- The players.
- Focus of interest.
- KPIs: individual modes.
- KPIs: individual corridors.

## **Corridor KPIs**

- Focus is “KPIs for supply chains”.
- Service along a corridor by mode.
- Focus: national, European and global
- Commercially meaningful.
- Enables modal choice decision making.

## **Corridor KPIs: stages**

- Identify flow patterns.
- Select important corridors.
- Formulate KPIs through “corridor forums”.
- Compare modal service performance.
- Establish performance standards by mode.
- Assess infrastructure performance.
- Establish “corridor benchmarking clubs”.

## **The beneficiaries**

- ***Operators:*** Key service KPIs identified, infrastructure bottlenecks identified and effects qualified.
- ***Shippers:*** Relevant supply-chain KPIs identified, modal performance comparisons, KPIs corridor-specific and usable, informed modal split decisions, informed sustainability response possible, performance standards for unfamiliar modes, benchmarking/aggregation by corridor.
- ***Government:*** Key commercial corridors identified, infrastructure issues identified, infrastructure investment prioritised, modal realignment message strengthened, consistent comparison across EU Member States.



## **13. INTERMODAL TRANSPORT**

*by*

**Anthony Ockwell, OECD**

Intermodal transport solutions have the potential to improve efficiency and promote sustainable transport development. Despite a goal to promote intermodal transport in most OECD countries, there are still a number of barriers to integrated transport solutions and the growth in transport is still taking place mostly on roads.

In 1998, the OECD established an Intermodal Freight Transport Advisory Group to identify key areas for research on intermodal transport from a global perspective. The following four areas have been identified for research: Institutional Aspects, Benchmarking, Economic Instruments, and International Freight Transport Corridors.

The Working Group on *Institutional Aspects* has compared different organisational structures and their capacity to deliver cohesive integrated transport policies. Transport policy and organisational structures have mainly developed along modal lines, which may hinder a co-ordinated intermodal approach. The project will compare transport organisational structures and regulatory reforms in Member countries. A final report will be available by mid-2000.

The Working Group on *Benchmarking* is aiming at developing benchmarks for assessing the relative efficiency of modes/modal combinations and intermodal transfers, and to identify sources of inefficiency that could contribute to modal choice. This work is focusing on the development of indicators based on total factor productivity analysis, and applying those to transport systems, including intermodal connections. A final report will be available by the end of year 2000.

The following countries and organisations are participating in the Intermodal Freight Transport Advisory Group: Austria, Canada, Czech Republic, Finland, France, Italy, Japan, Mexico, Netherlands (chair), Norway, Poland, Portugal, Sweden, Switzerland, United Kingdom, United States, the World Bank, ECMT, European Commission and APEC. Project descriptions for two relevant Working Groups are attached in Annex I.

For further information please contact OECD, Division of Transport, RTR Programme: Dr. Anthony Ockwell (phone: +33 1 45 24 95 96. E-mail: [anthony.ockwell@oecd.org](mailto:anthony.ockwell@oecd.org)) or Mr John White (phone: + 33 1 45 24 95 98. E-mail: [john.white@oecd.org](mailto:john.white@oecd.org)).

## ANNEX I: DRAFT PROJECT PROPOSALS

### INSTITUTIONAL ASPECTS

**Focus:** Review of the government sector to improve, if necessary, intermodal efficiency.

**Expected outcome:** Increased effectiveness in the development and implementation of multi-modal/intermodal transport policies that have the capacity to deliver a seamless transport system.

**Expected output:** Recommendations on effective organisational structures for governments in order to develop integrated transport policies.

**Objective:** The aim of this project would be to compare and assess the impact of different organisational structures on transport planning and policy development.

**Key issues:** While transport planning recognises the importance of developing and implementing a multi-modal perspective to transport planning and infrastructure investment, there are few examples of organisations providing an integrated approach to freight transport. For the most part, transport policy has proceeded along modal lines with emphasis being placed on regulatory reform and infrastructure provision and management. One of the main problems associated with the lack of a co-ordinated approach to transport investment and operational management has been a breakdown in the chain of responsibility, which is contrary to the effective development of intermodalism. As a result, there has been little focus given to the benefits likely to arise from a single organisation developing priorities for infrastructure investment across modes, infrastructure investment to address multi-modal/intermodal priorities, or regulatory reform that adopts an integrated transport approach.

**Tasks:** The project should focus on:

- the development of benchmarks to compare the effectiveness of different organisational structures on delivering cohesive transport policies;
- comparing different national and international organisations and their mechanisms to develop integrated transport policy options; and
- assessing the extent to which countries are reviewing regulations to improve intermodal transport, with consideration being given to the current state of play for transport policy making.

## BENCHMARKING

**Focus:** Comparison of the relative efficiency of modes, modal combinations and modal interfaces.

**Expected outcome:** Improvement in the operational efficiency of:

- modes/modal combinations in transporting contestable commodity types; and
- ports and terminals at the modal interface.

**Expected output:** Develop policy options to improve the efficiency of modes/modal combinations, ports and terminals.

**Objective:** The purpose of the project is to develop benchmarks for assessing the relative efficiency of modes/modal combinations and intermodal transfers, and to identify sources of inefficiency that could contribute to modal choice.

**Key issues:** For many product types (e.g. bulk commodities, express/urgent products) modal choice is not an issue. However, for some product types within that range, the transport market is contestable, not only between modes, but also between a given mode and a modal combination. Furthermore, within that market, there may be sharp differences in relative performance that contribute to the choice of transport by users (e.g. cost, reliability, time, damage, and flexibility).

Transfer points (road/rail, road/rail/seaport, road/rail/airport) represent key points in the transport chain, and in many cases, are major impediments to intermodal efficiency. This inefficiency is often related to uncertainty about who should take (overall) responsibility for their development, and partly because ports and terminals have evolved and may not be located optimally with regard to current and forecast needs. While several studies have focused on the operational efficiency of ports like Singapore and Rotterdam, there appear to be few studies which have attempted to compare the efficiency of ports and terminals at the modal interface (e.g. rail and truck turnaround times), including the local access to such facilities and the interaction with non-freight traffic.

**Tasks:** The focus of the project would be:

- the review of studies on transport benchmarking and the data available;
- the development of benchmarks to assess the performance of modes and modal combinations;
- the development of benchmarks to assess the performance of ports and terminals at the modal interface;
- the application of the benchmarks to key transport corridors and commodities to enable comparative assessments to be made;
- the identification of factors contributing to differences in their performance; and
- the development of policy options to improve performance.



## **SUMMARY OF DISCUSSIONS AND CONCLUSIONS**



The impressive number of NGOs, universities, academies and member countries attending this conference shows the importance of the subject. It should nevertheless be borne in mind that the conference was not about the benchmarking of enterprises (they already do this themselves), but benchmarking policy. It therefore dealt with problems of sustainable development, the environment (TERM report), employment, trans-European networks, etc.

If the term "benchmarking", translated as "étalonnage" in French, is now in vogue, the practice itself is an old one. What makes this a modern approach is the emergence of new factors, which the conference, organised jointly by the ECMT and the European Commission, was to examine. The conference had to answer three questions:

- What is benchmarking?
- Can this approach be of use in setting policy?
- What lessons can be drawn by governments, the European Commission and the ECMT ?

## **Benchmarking: methodology and specific problems**

### ***General methodology of benchmarking (report by Werner Wobbe)***

Before it became an instrument in a multi-layer strategy for improving performance, benchmarking was used to solve a fundamental problem: how is an economic actor to become and remain one of the best – if not the best – in his field of activity. This requires sound analysis of his own performance and those of his major competitors. It therefore involves a continuous learning process, involving the setting of targets in the form of clearly quantified objects for the purposes of comparison.

Furthermore, the main requirement of the process is the full participation of all the actors involved in the benchmarking programme, and above all those at the senior policy-making level of the organisation concerned. Benchmarking should not be seen merely as a process of establishing a standard or as a short-term cost-cutting instrument.

Successful benchmarking therefore requires four essential elements:

- High-level commitment on the part of policy makers.
- Analytic support structure.
- Testing and learning mechanisms.
- Preliminary assessment followed by on-going monitoring of the process.

### ***Benchmarking in transport (report by Gunnard Bärlund)***

If the nature of benchmarking is to be properly understood, some problems of definition must first be addressed. Thus:

- An objective is an ideal situation towards which we must strive.
- An interim target is a concrete and measurable goal that must be reached.
- An instrument is used to achieve the targets and thus the objectives set.
- Benchmarking is used to compare one's activities and targets with those of competitors.

In the framework of the European Union Common Transport Policy, benchmarking is used to satisfy the main aim of ensuring that different transport modes are in line with the objectives defined.

The merits of this approach are not self-evident, for even if the different member countries of the European Union have access to large quantities of numerical data, the transport sector and its effectiveness depend on numerous exogenous factors, such as climatic conditions or the demographic structure of the population, which cannot be taken into account in an explicit way. Consequently, where certain goals are not measurable, it may be necessary to give a clear outline of the ways of attaining them. For example, there are no tools for comparing the quality of transport systems internationally, but it is still possible to improve quality by defining objectives and targets without using numerical data. This simply means that great care should be taken when certain data are manipulated; moreover, it is essential to remain pragmatic.

### ***Benchmarking and European Commission transport policy (report by Richard Deiss)***

Many indicators can be used to study the European transport system, such as modal split, safety, freight levels and CO<sub>2</sub> emissions. Nevertheless, the selection of indicators is a crucial step in the benchmarking process: it is advisable to take care when handling data, because absolute national statistics do not take account of features specific to each country and relative statistics cannot filter out structural differences between countries.

It is therefore necessary to view possible interpretations of available data with the utmost caution. Even more importantly, it must be possible to obtain statistics that are most appropriate to the policy that is subject to benchmarking. On the other hand, considerable work is required to improve the quality of statistics to ensure that results and benchmarks are more reliable.

### ***Data quality problems (report by Stephan Rommerskirschen)***

The European Union transport policy needs reliable benchmarks if it is to be successful. These measures are essential, since an essential stage in benchmarking consists in the evaluation and comparison of the performance of different actors and of the instruments used.

The fact is that there are many problems regarding quality at European level. More often than not the statistics provided are incomplete and the definitions of the ways in which indicators are calculated are frequently neglected. It must be added that the time taken to produce them is far too long, which means that the statistical studies are already out of date by the time they become available.

If they are to be more reliable and of greater value in the benchmarking process, statistics should have five fundamental features:

- The information must be complete.
- The data must be valid.
- The data must be up-dated, and therefore up to date.
- The data must be transparent, i.e. the way in which they have been collected must be clearly explained.
- Lastly, the available data must be easy to use.

## **Concrete examples**

### **Road safety (report by Kare Rumar)**

There are no plans for benchmarking in the field of road safety. But there are substantial differences between countries: indicators vary by between one and seven from one country to another. This rather suggests that benchmarking might be of use in identifying the right policies.

*The advantages of benchmarking for road safety:*

The impact of a benchmarking study should be immense, in view of the differences between countries. If these differences are examined, it should be possible to identify the most effective measure and apply them in all countries.

*Problems encountered:*

- The data: given the quality of available data, the problem can only be studied in terms of fatalities. This dispenses with all problems associated with accidents that do not result in death. But in a multi-layer policy, the problem of road deaths would appear to be more important.
- A difficult objective to grasp: it is essential to envisage a zero death rate. This is a difficult idea to accept, but a necessary one. It is already assumed in rail, air and sea travel but presents a problem with respect to roads. Deaths are nevertheless unacceptable, and if the objective of eliminating them is to be pursued, adequate measures must be taken.
- The difficulty of putting concrete measures in place: road safety is always seen as a curb on mobility and it is difficult to put the right measures in place. For example, studies show that a pedestrian struck by a vehicle travelling at more than 40 km/h cannot survive; nevertheless, the legal speed limit in built-up areas is still 50 km/h, which means that actual speeds are 60 km/h.

### **Energy consumption indicators and CO<sub>2</sub> production (report by Lee Schipper)**

In face of the increasing strength of environmental concerns, it is necessary to have indicators for energy consumption and its effect on the environment, particularly in the transport sector.

*The advantages of benchmarking:*

Benchmarking provides a better understanding of pollution caused by fuel consumption in different countries. This work is fundamental to compliance with the Kyoto Protocol and is an essential element in the attempt to forecast the effects of certain measures on changes in the availability of fuel resources and on consequent pollution levels.

*Problems encountered:*

- The data: many analyses of the concrete situation are possible, especially as it is not fully known. For example, tests to measure motor vehicle pollutant emissions are conducted on a circuit and not in real traffic conditions. Moreover, with the chemical transformation of the elements, it is not always possible to identify the real source.

- Establishing standards: it is becoming very difficult to establish mandatory standards because they become a source of contention and controversy. Successful standardisation of measures implemented is therefore urgent and necessary.

*Ensuing discussion:*

It emerged that a European Union working party is addressing these questions with a view to gaining a better understanding of the situation. Moreover, the way in which policy decisions were made without any really reliable data prompted some surprise.

***Transport and environment indicators (report by Ann Dom)***

In 1998 the Cardiff Summit made the environment a cross-sector policy issue: problems related to the environment cannot be regarded as the sole responsibility of environment ministers; an analysis that cuts across all sectors of the economy is therefore necessary. The Treaty of Amsterdam thus provides for an environmental action programme within the Community.

An instrument was required to assess progress made by different countries, hence the idea of the TERM project (Transport and Environment Reporting Mechanism).

*The advantages of benchmarking in environmental policy*

This instrument is used to compare countries and monitor progress.

The development of a common statistical base would enable a true comparison to be made and open the way to a solution to the statistics problems referred to above. So that progress can be assessed, the objectives of policy should be set on the basis of the indicators. This tool will provide for a better dialogue between actors and will make transport policy more transparent to the public.

*Problems encountered*

- The data: we have already observed the problems encountered in gathering sound statistical data. These problems are even greater in the field of the environment. Three quarters of the TERM indicators presented problems. For example, there are a lot of data on noise, but they are not comparable. It was necessary to put pressure on all countries in an attempt to achieve harmonised data. Such harmonisation is difficult because the indicators relate to different countries, modes, products and societies.
- The indicators: if the indicators are not sufficiently differentiated, they fail to show how the environment can be influenced. The indicators are still not sufficiently differentiated to allow adequate targeting of objectives. For example, a distinction should be made between petrol and diesel driven cars.
- The objectives: although most objectives are quantitative, they are not sufficiently precise. For example, the Kyoto protocol does not specify work to be done by different sectors, and it defines non-quantitative objectives (improving the modal split, effective charging, etc.).

### *Ensuing discussion:*

Discussion highlighted the innovative aspect of this initiative. The work is on the right lines and makes a useful tool available to everybody. In the light of the Kyoto results, there is an increasing trend towards describing objectives in terms of figures. This trend is linked to comparative analysis, though different countries are reluctant to spell out precise objectives.

This work has undeniable value for the production of quality statistical data, but there is still concern over the extent to which the data are not differentiated. It is essential to break them down so that choices can be made.

### **Rail transport (report by Chris Nash)**

In the seventies, a study was commissioned in which different European railways were compared. The intention here is to show why benchmarking is important in the rail sector.

#### *The advantages of benchmarking in the rail sector*

There is a revival of interest in that greater attention is now being paid to the efficiency of railways. This efficiency can be studied in terms of the many different types of organisation to be found in different countries. This attention is particularly important as the regulation of the railways is currently raising a number of questions.

#### *Problems encountered*

- The data: one of the major problems is the lack of common definitions, which constitute an essential precondition if results are to have any value. It is important to make a clear distinction between all non-rail activities, to take account of depreciation and interest, to consider data on the personnel employed by the network, as well as the quality of rolling stock and tracks. It is also necessary to take account of different legal and safety requirements and of the general policy of the official authorities. But data is becoming increasingly difficult to obtain as there are around thirty different operators involved, all of whom sub-contract.
- The indicators: statistics are numerous, and are chiefly given in tonne-km and passenger-km. However, such indicators do not reflect different costs and cannot therefore be added up. The production process is complicated and it is necessary to take account of factors such as economies of scale. The key indicators can be divided into three categories: operational, commercial and financial. Safety and environmental factors have been added to these. With the three categories of key factors, it was possible to measure productivity to some extent. However, this approach provoked adverse criticism, which made other approaches necessary: total productivity of the factors, analysis of coverage of data, function of cost and production, and estimation of limits. These different approaches were complementary, rather than interchangeable.

### *Ensuing discussion*

The report presented highlighted the frailty of an indicator such as market share and sought to identify new sets of indicators. Whether it was more desirable to have figures that were clear but not correct or figures that were more complex but not transparent represented a serious dilemma. One might then wonder which performance indicator was the valid one.

It emerged in this connection that the growth in passenger transport was due to speed and that the current problem was freight. Europe does not have the same market share as the United States in this field, but wishes to arrest decline and stabilise its market share through a policy of promoting railways.

In comparing market shares for freight, account should be taken of the make-up of the goods. Added value is not the same for bulk materials as for finished goods. Data must therefore be carefully classified if comparisons are to be made.

Despite their limitations, statistics for the modal split are important, since one of the objectives is to identify the means of transport that causes the least pollution, i.e. the train. But a fall in the market share is disappointing, being contrary to EU objectives.

### ***Urban transport performance benchmarking (report by Paul Hodson)***

Given the many problems raised by the increasing use of the car, environmental impact and road congestion in particular, the authorities' wish to develop public transport is keenly felt. The European Commission accordingly devised a project to examine the performance of 15 cities and regions. These were: Athens, Bremen, Dresden, Edinburgh, Genoa, Graz, Ile de France, Lisbon, Merseyside, Nantes, Oulu, Prague, Strathclyde, Stuttgart and Terni.

#### *The advantages of urban transport performance benchmarking*

The participating cities and regions began by answering around a hundred and fifty questions on their transport system and its environment. In this way thirty indicators were identified, grouped in several categories:

- The essential features of the cities/regions (surface area, population)
- The extent of public transport use
- The availability of public transport (e.g. number of public transport stops per km<sup>2</sup>)
- The priority given to public transport (e.g. number of lanes restricted to public transport vehicles)
- The information made available to public transport users (e.g. annual expenditure on information services for public transport users)
- The attractiveness of public transport (e.g. monthly cost, not counting reductions, to the user of public transport).

It was thus possible to distinguish between agglomerations in terms of performance on the basis of the indicators.

In the second part of the project, the participating cities/regions worked together to study the good practice that some of them had implemented, in order to improve their understanding of the way in which it might be adopted.

#### *Problems encountered*

- The data: It is sometimes difficult to compare two agglomerations, their structures being so different. For example, Paris and the Ile de France have around eleven million inhabitants, whereas Terni has only a hundred thousand. The definitions chosen for the purpose of making calculations are not necessarily identical in different countries. Nevertheless, it is possible to correct the distortion to some extent on the basis of the trends that can be discerned over a period of time.
- The diversity of participants: certain countries have entrusted the management of public transport to the private sector, whereas in others it is run by local authorities. Consequently, participants do not have the same status and are not all in the same position to collect data, and this has rather delayed the process.

#### *Ensuing discussion:*

One of the major questions concerned the rationale for the choice of what constitutes good practice. In benchmarking the performance of urban transport, an overriding consideration is the desire of cities to develop in certain fields and it is impossible to have rigid standards. This is why there are plans to continue the exercise, involving other cities and concentrating more on particular fields.

#### ***Public transport (report by Bill Clarke)***

The report presented two experiments in which benchmarking was applied to metro systems: COMET and NOVA. The project involved many metros across the world, including small networks, and it was therefore possible to pool data on different practice.

The importance of metros is underscored by a single fact: if a strike affected 25 cities, global GDP would be affected.

#### *The advantages of a benchmarking policy*

Benchmarking has provided a solution to a problem that arose in Hong Kong: How can a network perform less well than other networks whose systems are obsolete?

The idea was to identify exemplary practice in order to improve the performance of the network. But it was emphasised that not all practice was necessarily applicable in all cases: a flexible attitude was maintained with respect to the applications that were to be implemented.

Benchmarking was facilitated by the fact that work was carried out in small groups and that there was no competition between the members involved in the process.

Methodology: a bottom-up mode was favoured, proceeding from the bottom to the top management level.

Results: solutions were found to specific problems: line management in London, maintenance in Hong Kong, improving safety in Berlin.

This also facilitated the exchange of information between engineers from different metros and within the various enterprises.

#### *Problems encountered*

- The data: Comparison of systems that differ substantially presents a problem. For example, some metros did not pay for electricity, others were provided with staff free of charge. The first problem to be faced by the group, therefore, was that of providing common statistics: this involved pooling methods and approaches. The exercise took five years in Berlin, and there is no knowing how long it will take in Moscow.
- The indicators: the number was limited to thirty three (as opposed to two hundred in certain networks), but these only concerned causes and effects. However, it was necessary to redefine these indicators to take account of differences between networks, the fact that staff salaries were different in Mexico and Paris, for example. This was made possible by applying methods with a rigour tempered by a certain flexibility.

#### *Ensuing discussion:*

It is important to emphasise that the method proved effective in a non-competitive framework. Nevertheless, the difficulty of obtaining figures must not be minimised. Even though the participants in a benchmarking exercise all accept the basic idea, time is still needed to adapt the statistics required.

Above all it emerged that public transport will only be efficient when inter-modal travel becomes a reality and in this respect the indicators are inadequate (for example, those related to cycle/bus-metro inter-modal transport, restricted lanes, etc.).

#### *Urban transport (report by Anne Grünkorn / Cleo POUW)*

The report presented outlined the POLIS project: a research network set up to find new transport solutions.

POLIS involves a network of cities from all member countries. It is an independent, non-profit making organisation founded in 1989, which brings together local authorities for the purpose of supporting the development of innovative solutions in transport and facilitating the exchange of ideas and knowledge.

*The advantages of benchmarking:*

The members of POLIS would be interested in participating in benchmarking projects on urban transport. Travel is associated with a great many activities, and urban concentration leads to greater transport demand. In this context, benchmarking studies would enable cities and regions to improve their networks.

***Maritime ports (report by Carsten Friedrichsen)***

Ten years ago, the regulatory authority of Danish ports was the Ministry of Transport, which made decisions on tariff increases, thus protecting the ports from competition. The ports have now been liberalised.

The report describes a benchmarking experiment involving eight Danish ports, the purpose of which was to improve their performance.

*The advantages of benchmarking:*

The efficiency of ports is important since they account for a large proportion of maritime transport costs: for example, they account for 95% of the cost of container transport inside the country. The fact is that clients of port facilities are generally only aware of the costs and delays associated with ports and do not appreciate the service provided. Benchmarking would therefore appear to provide a means of improving performance, for there are great differences between ports: the number of tonnes handled per hour per ship can vary by 30% more or less than the average

- Methodology: this was based on benchmarking related first to quality and subsequently to quantitative factors: market share, time, expenditure, “internal performance”, of the ports. The study then entered a third stage in which Danish ports were compared with Swedish ports so that the relative merits of another structure could be assessed. Lastly, a description was drawn up of the “good practice” to be introduced.
- Results: According to the assessment, there could be a 15% reduction in costs and a 10% gain in time in the maritime transport sector if “good practice” was introduced

*Ensuing discussion:*

This development was particularly interesting in that it concerned a sector that had just been liberalised.

***Benchmarking air freight services (report by Chris Welsh)***

In the air freight sector, logistics has assumed increasing importance in competition between operators. The purpose of the benchmarking process, originally requested by the clients of air cargo shippers, was to improve relations between all those involved in the sector and improve the effectiveness of the air cargo supply chain, from the shipper to the consignee.

### *The advantages:*

An initial programme was conducted in the United Kingdom and the operation was then extended to European level. The selected indicators are management tools and should provide a means of comparing performance in respect of takings, equipment and crews. They are used to identify flows and select the most important corridors, to establish performance standards and to set up “corridor benchmarking clubs”. This type of analysis should be extended to other modes of transport.

Several other advantages are expected from this initiative. It is thus possible for operators to identify bottlenecks in the infrastructure and to quantify their effects. This enables the different companies to compare the intrinsic performance of each mode of transport and each corridor, and to standardise indicators for modes they are unfamiliar with.

### *Problems encountered*

- The data: each participant in the programme is required to provide all necessary data. This should be processed by computer and submission of results should be formalised.
- Use of indicators: this is the main problem. Some actors still fail to appreciate the purpose of the indicators and therefore have difficulty in implementing a suitable response.

### *Ensuing discussion:*

This is an innovative approach, instigated by demand for the service, and thus demonstrating that benchmarking is not the prerogative of the supply side. While being on the right lines, the analyses are too often determined by the infrastructures; the view of demand taken by this approach can modify the results quite significantly.

## **Conclusions**

The conference responded to the issues, raised in the form of the three questions, in the following way:

### ***What is benchmarking?***

This seems to have been the question to which the conference gave the best reply. However, the reaction of certain participants shows that benchmarking encompasses different practices. The same basic concept produces differing interpretations: benchmarking is seen as a simple statistical tool, as an effective means of applying political pressure, as a process of determining standards, or as a process of comparative analysis.....there is no simple answer to the question. Benchmarking covers different practices which have the common goal of comparing oneself with others. But they can lead to more elaborate practice, dynamic or static, and more or less codified. At the conference we saw examples of success, but we were also shown fields in which this instrument has not worked as expected.

The conference showed the need for an all-embracing approach if effective use is to be made of this type of initiative in the transport sector. In order to produce transport networks of high quality, it is necessary to benchmark the entire supply chain, keeping in mind the single market and new

technologies. Research into benchmarking must therefore be developed, and it would probably be advisable to launch research programmes on particular subjects in order to identify more clearly the areas in which this methodological tool might be applied in the transport sector.

### ***Can this approach be of use in setting policy?***

All the examples of successful cases of benchmarking demonstrate the possibility of using it to improve efficiency in the enterprises or networks concerned. With such an approach, it would be possible, by carrying out research and identifying "good practice", to define "good policy". Benchmarking in its most complex "comparative analysis" version really can be used to define policy.

In order to meet a policy objective of this kind, it is necessary to have concrete, measurable, clear, quantified objectives. To that end it is imperative that politicians should be fully involved in the whole benchmarking process and play a supportive role throughout the whole process. The way in which governments can facilitate or impose a minimum amount of benchmarking is a key element in the success of a strategy of this kind. Nevertheless, the silence of the different countries' representatives at the conference shows that many governmental authorities are adopting a wait-and-see attitude. The fact is, however, that the common factor in the successful cases of benchmarking is the high level of involvement on the part of the different actors.

### ***What lessons can be drawn by governments, the European Commission and the ECMT?***

Although the supportive role played by the political actors seems an important one, the most important task at present, the essential first stage, is to improve and harmonise statistics. While the conference enabled certain countries undergoing transition to appreciate the importance and complexity of the strategy, it must be acknowledged that these countries are at the most delicate stage of the process: that of producing sound statistics.

At this stage in the process a certain effort is required in all countries without exception; benchmarking calls for clear, consistent data. In no instance can benchmarking be conducted without sound data and sound analysis. However, as matters stand, the improvement of data is an absolute necessity since national statistics are often very mediocre. The conference showed that it is possible to improve statistics at national level by rationalising procedures: reducing the number of questionnaires, using more relevant indicators, etc. Data collection must be developed at this level and the contributions of the European Commission and the ECMT are essential in this respect. For this purpose the European Commission already uses the Internet, the purchase of data, etc., and it must continue along these lines. Problems of comparability remain, however; hence the importance of the TERM project, whose object is to improve the quality of the data collected. Generally speaking, if benchmarking procedures are to be successful, resources must be found to improve the quality and the collection of data. However, the relative silence of the countries' representatives reveals a passive interest. Although countries are interested, they do not seem prepared to invest very much in the field. The problem of comparison at international level is therefore likely to remain.



## **LIST OF PARTICIPANTS**



## **MEMBER COUNTRIES**

### **CZECH REPUBLIC**

Mr Vladimir SLAVICEK  
First secretary Mission of the Czech Republic  
to the European Communities  
15 rue Caroly,  
B-1050 Brussels

Tel +32 2 2130 144  
[eu.brussels@embassy.mzv.cz](mailto:eu.brussels@embassy.mzv.cz)  
[vladimir\\_slavicek@mzv.cz](mailto:vladimir_slavicek@mzv.cz)

Mrs Ludmila AMBLEROVA  
Deputy Director  
Ministry of Transport and Communications  
Nabr Ludvika Svobody 12/22 - P.O. Box 9  
CZ-11015 Praha 1

Tel +420 2 514 31 446  
[Amblerov@mdcr.cz](mailto:Amblerov@mdcr.cz)

Mr Josef ZATLOUKAL  
Director Transport Policy  
Ministry of Transport and Communications  
Nabr Ludvika Svobody 12/22 - P.O. Box 9  
CZ-11015 Praha 1

Tel. +420 2 514 31 075  
[Zatlouka@mdcr.cz](mailto:Zatlouka@mdcr.cz)

### **ESTONIA**

Mr Ago TIIIMAN  
Adviser  
Estonian Mission to the EU  
Rue Marie-Thérèse 1/3  
B-Brussels 1000

Tel +32 2 227 39 10  
[Ago.tiiman@eu.estemb.be](mailto:Ago.tiiman@eu.estemb.be)

Mr Peeter SKEPAST  
Deputy Secretary General  
Ministry of Transport  
9 Vizu str.,  
EST-Tallinn 15081

Tel +372 6 397614  
[Peeter@tsm.ee](mailto:Peeter@tsm.ee)

## **FRANCE**

M. Yves GEFFRIN  
Chef de la Mission de la recherche et de l'innovation  
dans les transports  
Ministère de l'Equipement et des Transports  
Tour Pascal B, 15e étage  
F-92055 Paris la Défense Cedex

Tel +33 1 4081 1411  
[josephau@drast.equipement.gouv.fr](mailto:josephau@drast.equipement.gouv.fr)

Mme Elisabeth BOUFFARD SAVARY  
Ministère des Transports  
Direction Générale de l'Aviation Civile  
50, rue Henri Farman  
F-75720 Paris Cedex 15

Tel +33 1 58 09 48 76  
[Savary\\_Elisabeth@dta.dgac.fr](mailto:Savary_Elisabeth@dta.dgac.fr)

M. Frédéric GUIGNIER  
Ministère des Transports  
Direction Générale de l'Aviation Civile  
50, rue Henri Farman  
F-75720 PARIS Cedex 15

Tel +33 1 58 09 41 54  
[Guignier\\_Frederic@sba.dgac.fr](mailto:Guignier_Frederic@sba.dgac.fr)

M. Alexandre CROZAT  
Ministère des transports  
Direction Générale de l'Aviation Civile  
50, rue Henri Farman  
F-75720 Paris Cedex 15

Tel +33 1 58 09 42 99  
[Crozat\\_Alexandre@dta.dgac.fr](mailto:Crozat_Alexandre@dta.dgac.fr)

## **GREECE**

Mr. T. PAPATRIANTAFYLLOU  
Technical Inspector  
Ministry of Transport  
Anastaseos and Tsigante Street  
GR-10191 Athens

Tel +30 1 6508480  
[Phaethon@hol.gr](mailto:Phaethon@hol.gr)

**Greece (continued)**

Mr Vasilis KALLIVOKAS  
Ministry of Transport and Communications  
Anastaseos and Tsigante Street  
GR-10191 Athens

Tel +30 1 6508 507  
[Ymediesx@hol.gr](mailto:Ymediesx@hol.gr)

**IRELAND**

Mr Richard O'REILLY  
Assistant principal  
Road haulage division  
Department of public enterprise  
Frederick building,  
St Frederick Street,  
IRL-Dublin 2

Tél. +353 1 604 1136  
[Oreillyr@tec.irlgov.ie](mailto:Oreillyr@tec.irlgov.ie)

**LITHUANIA**

Mrs Raimonda LIUTKEVICIENE  
Transport Attaché  
Mission of the Republic of Lithuania to the EU  
Avenue des Cinq Bonniers 51  
BRUXELLES B-1150  
Belgique

Tel +32 2 779 82 72  
[Raimonda.Liutkeviciene@H-mission-eu.be](mailto:Raimonda.Liutkeviciene@H-mission-eu.be)

**NETHERLANDS**

Mrs Henriette NOORDHOF  
Ministry of Transport  
Transport Research Centre  
POB 1031  
NL-Rotterdam 3000 BA

Tel +31 10 282 5942  
[h.noordhof@avv.rws.minvenw.nl](mailto:h.noordhof@avv.rws.minvenw.nl)

**NORWAY**

Mr Thor K. HAATVEIT  
Samferdseldepartement  
PB 8010  
NO-0030 Oslo

Tel +47 22 24 8254  
[thor.haatveit@sd.dep.telemex.no](mailto:thor.haatveit@sd.dep.telemex.no)

<b>Norway (continued)</b>	Mrs Brita BYE Adviser Samferdseldepartement PB 8010 NO-0030 Oslo
	Tel +47 22 24 8211 <u>A-Brita Bye</u>
<b>POLAND</b>	Mrs Janina MENTRAK Deputy Director Ministry of Transport Department of Maritime Transport 46 Chalubinskiego Str. PL-00928 Warsaw
	Tel +48 22 628 82 26 <u>mlepkowski@mtigm.gov.pl</u>
<b>SPAIN</b>	Juan Carlos HUERTAS DE ANDRES Miisterio de Fomento Paseo de la Castellana 67 E-28071 Madrid
	Tel +34 1 91 597 5031 <u>jchuertas@mifom.es</u>
<b>SWITZERLAND</b>	Dr. Thomas ISENMANN Deputy section head Federal Office of Transport Bundeshaus Nord CH 3003 Bern
	Tel +41 31 322 5846 <u>Thomas.isenmann@bav.admin.ch</u>
	Mr Ulrich SCHLUP Head of unit Federal Department of Environment, Transport ASTRA, CH-3003 Berne
	Tél <u>ulrich.schlup@astr.admin.ch</u>

**UNITED KINGDOM** Mr Timothy WELLBURN  
DETR  
Great Minster house 4/19  
Marsham street,  
GB-London SW19DR

Tel +44 171 890 5451  
[Timothy\\_wellburn@detr.gsi.gov.uk](mailto:Timothy_wellburn@detr.gsi.gov.uk)

Mr Mike HUGHES  
Chief Statistician  
Gtransport Statistics - Freight  
DETR  
Zone 1/26 Great Minister House  
76 Marsham street  
GB-London SW1P 4DR

Tel. + 11 171 890 4280  
[Mike\\_hughes@detr.gsi.gov.uk](mailto:Mike_hughes@detr.gsi.gov.uk)

## TRANSPORT ASSOCIATIONS

**AEA** Mr Dario SPILA  
Association of European Research Analyst  
Airlines Avenue Louise 350  
1050 Brussels

Tel +32 2 639 8989  
[Dario.spila@aea.be](mailto:Dario.spila@aea.be)

**CCFE-CER-GEB** M. Maurice HOWARD  
Conseiller économique  
Communauté des Chemins de Fer Européens  
B1 de l'Impératrice 13, bte 11  
B-1000 Bruxelles

Tél. (32 2) 525 90 62  
[Mhoward@cer.be](mailto:Mhoward@cer.be)

<b>ECF</b> European Cyclists Federation	Mrs Marie Caroline COPPIETERS Secretary General 15 Rue de Londres, (b.3) 1050 Brussels
	Tel +32 2 512 98 27 <u><a href="mailto:office@ecf..com">office@ecf..com</a></u>
<b>EFIP</b> European Federation of Inland Ports	Mrs Karin de SCHEPPER Secretary General Place des Armateurs 6, B-1000 Brussels
	Tel +32 2 420 70 37 <u><a href="mailto:Efip@skynet.be">Efip@skynet.be</a></u>
<b>ESC European Shippers Council</b>	Mr Chris WELSH 40, rue Joseph II B-1000 Brussels
	Tel +32 2 230 21 13 <u><a href="mailto:Cwelsch@fta.co.uk">Cwelsch@fta.co.uk</a></u> <u><a href="mailto:esc@pophost.eunet.be">esc@pophost.eunet.be</a></u>
<b>ESPO</b> European Seaports Organisation	Mrs Pamela LE GARREC Secretary General Avenue Michel Ange 68 B-1000 Brussels
	Tel +32 2 736 34 63 <u><a href="mailto:Espo@hebel.net">Espo@hebel.net</a></u>
	Mr Hanneke de LEEUW Adviser Avenue Michel Ange 68 B-1000 Brussels
	Tel +32 2 736 34 63 <u><a href="mailto:Espo@hebel.net">Espo@hebel.net</a></u>
<b>FREPORT</b>	Mr Patrick VERHOEVEN Secretary General Michelangelolaan 68 B-1000 Brussels
	Tel +32 2736 75 52 <u><a href="mailto:Fepo@skynet.be">Fepo@skynet.be</a></u>

<b>Finnish Railways</b>	Mr Gunnar BÄRLUND
<b>VR</b>	Director International Affairs
	Vilhonkatu 13
	POB 488
	FIN-00101 Helsinki
	Tel +358 9 707 3914
	Mob. Tel +358 405 473 637
	<u>Gunnar.Barlund@vr.fi</u>
<b>London Transport</b>	Mr Bill CLARKE, MA, FCIT, FRSA
	Consultant
	4 Oakvale Court
	Dorrington
	UK-Shrewsbury SY5 7JW
	Tel +44 1743 718520
	<u>Wrclarke@gofornet.co.uk</u>
<b>NEA</b>	Arnaud BURGESS
	Project Leader
	Polakweg 13
	POB 1969
	NL-2280 DZ Rijswijk
	Tel +31 70 39 88 305
	<u>Phi@nea.nl</u>
<b>OGM</b>	Mr Nikki JAMES
	Avenue d'Auderghem 92
	B-1040 Bruxelles
	Tel +322 737 9680
	<u>Nikki.james@ogm.be</u>
<b>PLS Consult</b>	Mr Carsten FRIEDRICHSEN
	Olof Palmes Allé 20
	DK-8200 Aarhus N
	Tel + 45 89 44 78 12
	<u>CFR@pls.dk</u>

<b>Polis</b>	Mrs Cleo POUW (represents POLIS) City of Rotterdam POB 6575 3002 AN Rotterdam
	Tel +31 10 4897 107 <a href="mailto:c.pouw@obr.rotterdam.nl">c.pouw@obr.rotterdam.nl</a>
<b>PRI</b> La Prévention Routière Internationale	Mr José Miguel TRIGOSO 75, rue de Mamer BP 40 L-8005 Bertrange
	Tel +352 318 341 <a href="mailto:Int.road.safety@pri.lu">Int.road.safety@pri.lu</a>
<b>Prognos AG</b>	Mr Stefan ROMMERSKIRCHEN Head of Transport Division Missionsstr.62 CH-4012 Basel
	Tel +41 61 3273 337 <a href="mailto:Stefan.rommerskirchen@prognos.com">Stefan.rommerskirchen@prognos.com</a>
<b>SNCF</b>	M. Hassan SALMAN Direction de la Stratégie Département Economie 34, rue du Commandant Mouchette F-75000 Paris
	Tél + 33 1 53 25 30 64 <a href="mailto:Hassan.salman@sncf.fr">Hassan.salman@sncf.fr</a>
	Mme Anne LENORMAND Direction de la Stratégie Département Economie-SNCF 34, rue du Commandant Mouchette F-75000 Paris
	Tel. + 33 1 53 25 30 62 <a href="mailto:Anne.lenormand@sncf.fr">Anne.lenormand@sncf.fr</a>

<b>UIC</b>	Mr David NIVEN REED Senior Adviser 16, rue Jean Rey F-75015 Paris
	Tel +33 1 44 49 21 03 <a href="mailto:cornet@uic.asso.fr">cornet@uic.asso.fr</a>
<b>University of Leeds</b>	Mr Christopher NASH University of Leeds Institute for Transport Studies GB-Leeds LS2 9JT,
	Tél. +44 113 233 53 37 <a href="mailto:Cnash@its.leeds.ac.uk">Cnash@its.leeds.ac.uk</a> <a href="mailto:(C.a.nash@its.leeds.ac.uk)">(C.a.nash@its.leeds.ac.uk)</a>
<b>UIRR</b>	Mr Rudy COLLE Director General 31 Rue Montoyer bte 11 B-1000 Brussels
	Tel +32 2 548 78 90 <a href="mailto:Headoffice.brussels@uirr.com">Headoffice.brussels@uirr.com</a>
<b>UITP</b>	Mr Rolf WAARA Av. Hermann Debroux 17 B-1160 Brussels
	Tel +32 2 663 6628 <a href="mailto:rolf.waara@uitp.com">rolf.waara@uitp.com</a>
<b>VTI (Sécurité Routière)</b>	Mr Kare RUMAR Research Director Swedish Road and Traffic Research Institute (VTI) dev AB Po box 426 S - 581 04 LINKOPING
	Tel +46 1312 36939 <a href="mailto:Kare.Rumar@vti-utveckling.se">Kare.Rumar@vti-utveckling.se</a>

## INTERNATIONAL ORGANISATIONS

**AIE**

Mr Lee SCHIPPER  
Rue de la Fédération 9  
F-75739 Paris Cedex 15

Tel +33 1 40 57 67 14  
[Ljsocd@dante.lbl.gov](mailto:Ljsocd@dante.lbl.gov)

**OCDE**

Ms Maj THEANDER  
STI/DOT  
2, Rue André Pascal,  
F-75775 Paris Cedex 16

Tél. 33 1 45 24 95 98  
[Maj.theander@oecd.org](mailto:Maj.theander@oecd.org)

Mr. Antony OCKWELL  
Principal Administrator  
OECD - STI/DOT  
2, rue André Pascal  
F-75775 Paris Cedex 16

Tel. +33 1 45 24 95 96  
[Anthony.Ockwell@oecd.org](mailto:Anthony.Ockwell@oecd.org)

**ONU  
Nations Unies**

Mrs Brinda WACHS SHIMIZU  
Palais des Nations,  
Economic Affairs Officer  
Transport Division  
8-14, av. de la Paix  
CH- 1211 Geneva 10

Tél. +41 22 917 24 52  
[Brinda.shimizu@unece.org](mailto:Brinda.shimizu@unece.org)

**EUROPEAN COMMISSION (EC)**

<b>Commission DG Transport</b>	Mr. Jan-Peter PAUL Rue de la Loi 200 B-1049 Bruxelles BU 31 5/26 Tel +32 2 296 8237 <a href="mailto:Jan-Peter.Paul@cec.eu.int">Jan-Peter.Paul@cec.eu.int</a>	<b>Commission Autres DGs</b>	Mr Werner WOBBE Rue de la Loi 200 B-1049 Bruxelles SC 15 5/177 Tel +32 2 29 508 79 <a href="mailto:Werner.Wobbe@cec.eu.int">Werner.Wobbe@cec.eu.int</a>
	Mr. Richard DEISS Rue de la Loi 200 B-1049 Bruxelles BU 31 5/18 Tel +32 2 296 8237 <a href="mailto:Richard.Deiss@cec.eu.int">Richard.Deiss@cec.eu.int</a>	<b>Commission Eurostat</b>	Mr Ovidio CROCICCHI L-2920 Luxembourg Bech Building Tel +352 4301 33608 <a href="mailto:Ovidio.Crocicchi@cec.eu.int">Ovidio.Crocicchi@cec.eu.int</a>
	Mr. Paul HODSON Rue de la Loi 200 B-1049 Bruxelles DM 28 04/16 Tel +32 29 91258 <a href="mailto:Paul.Hodson@cec.eu.int">Paul.Hodson@cec.eu.int</a>		Mr Hans STRELOW L-2920 Luxembourg Bech Building Tel +352 4301 34580 <a href="mailto:Hans.Strelow@cec.eu.int">Hans.Strelow@cec.eu.int</a>
	Mrs Anna PANAGOPOULOU Rue de la Loi 200 B-1049 Bruxelles DM 28 07/88 Tel +32 2 29 67894 <a href="mailto:Anna.Panagopoulou@cec.eu.int">Anna.Panagopoulou@cec.eu.int</a>	<b>EEA</b>	Mrs Ann DOM Kongens Nytorv 6 DK-1050 Copenhagen K Tel +45 33 36 71 31 <a href="mailto:Ann.Dom@eea.eu.int">Ann.Dom@eea.eu.int</a>
	Mrs PICHEREAU Secretary DG Transport	<b>ECMT Secretariat</b> 2, rue André Pascal F-75775 Paris	
	Mr Jack SHORT Deputy Secretary General Tél. +33 1 45 24 97 21 <a href="mailto:Jack.Short@oecd.org">Jack.Short@oecd.org</a>		Mr Mario BARRETO Administrator Tél. +33 1 45 24 97 22 <a href="mailto:Mario.Barreto@oecd.org">Mario.Barreto@oecd.org</a>
	M. Alain RATHERY Head of Division Tél. +33 1 45 24 97 16 <a href="mailto:Alain.Rathery@oecd.org">Alain.Rathery@oecd.org</a>		Mrs Julie PAILLIEZ Assistant Mme Maryvonne LEBOUC Secretary

**Rapporteurs :** M. Pierre CAUMONT et M. François PIGUET

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